



# ANNALS OF SURGERY

A MONTHLY REVIEW OF SURGICAL SCIENCE AND PRACTICE

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## NOTES ON SERVICE IN THE FRENCH ARMY MEDICAL CORPS

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MÉDECIN AIDE MAJOR DE 2<sup>e</sup> CLASSE DE L'ARMÉE FRANÇAISE

It should be stated at the outset that this paper makes no pretence of being a scientific compilation of statistics. It would be presumptuous for me to attempt such a thing with the comparatively limited experience I have had. The French are keeping remarkably detailed histories of each wound, with the ultimate result that the question of pensions after the war will be made much easier and, of far greater importance to the world at large, that immensely valuable statistics of wounds, their treatment, progress and results will be available. In fact, much has already been written.

Rather let me attempt to give some idea of the routine work and experiences that come to a Médecin Aide Major in the French Army, this rank corresponding to the rank of Lieutenant in the United States Army Medical Corps. My service so far has covered a period of some seven months only. As soon as given my appointment I was assigned to the Fifth Region, of which Orléans is the headquarters. The first month I was attached to three different hospitals in that city to give me a chance to learn the ropes a bit before I was given a surgical service of my own. Here I assisted at operations and dressings and began to get an idea of the ordinary routine treatment of war wounds. Dr. Lenormant was "Surgeon of the Sector" here, and I had the pleasure of seeing, and occasionally assisting, with his work. His technic was clean-cut and his manual skill quite evident.

After a month here I was sent to Melun, a city of some fourteen thousand, also in the Fifth Region, on the main line of the P. L. M., forty-five kilometres (an hour by train) south of Paris. There were six military hospitals in the city, including the "Hôpital Mixte," or civil hospital, now "mixed" because it took care of both civil and military cases. I was assigned to "Hôpital Militaire No. 12," which had 266 beds. Excepting "Hôpital Mixte" this was the largest hospital in the town. It occupies about one-half of the Collège Jacques Amyot—a good-sized building, corresponding somewhat with a boy's preparatory school, such as is found near all large cities in this country. Each hospital had from

one to three medical officers attached to it, No 12 having three. The "Médecin-Chef," who was the executive medical officer commanding, another "Médecin Aide Major" (not a surgeon), and myself.

It should be remembered that the French make a clear-cut distinction between physicians and surgeons. Of the latter there were only two others beside myself for the six hospitals, and one of these two, Dr Rocher, Professor of Surgery at Bordeaux, was "Surgeon of the Sector," and was responsible for all surgical work at Fontainebleau, a few miles away, as well as at Melun.

It might be stated that throughout France various buildings are now used for hospitals. The town hospital always, next most common are schools, then convents, barracks, etc.

These figures, of course, are not official, but I am told that there were approximately 20,000 doctors in France when the war broke out, that of these about 14,000 have been mobilized, and that of the latter, some 1500 have been killed or seriously disabled. Before the war there had been seven doctors at Melun, but six had been mobilized, leaving but one civilian physician, not a surgeon, in town. This meant that the military surgeons had all the surgical work at Melun, including the civil surgery at Hôpital Mixte. The operating, because of the arrangement of operating rooms, X-ray apparatus, etc., was done at only four of the hospitals, the wounded being moved from one hospital to another as became necessary.

In addition to the hospital work already mentioned, the medical care of the troops in training, etc., at the various barracks in the town, the Gendarmes, the German prisoners of war working on the farms close by, as well as the emergency work among the population, including the Belgian and French refugees, that the lone civil practitioner left in the town could not get in, all fell to the medical officers attached to the various hospitals and was divided among them. A certain amount of this work fell to me, and I had civil cases from time to time ranging from pulmonary hemorrhage, ruptured varicose veins and tetanus, to infected fingers and miscarriages.

The food at the hospital was excellent. The man who was chef when I first arrived had been chef at the Café Royale in London when the war broke out. He brought all of his skill with him and the wounded received the benefit. Breakfast ordinarily consisted only of bread and coffee, but the lunch and dinner were hearty, well-cooked and well-served. A large tin cup of red wine went with each meal except breakfast. Special diet was provided whenever ordered. The officers had a bit more variety than the men and it was served in a little more dainty fashion. Before I left every man of the entire kitchen force had been sent to his regiment and replaced by a woman, but the service did not deteriorate.

I stayed at this hospital, No 12, until my return to the United States on furlough. As a service rarely lasts longer than six months without a change of location, I would have been transferred elsewhere very soon,

had I remained There was a constant change of personnel while I was at Melun, only two medical officers that had been there when I arrived still being there when I left

Medical officers at the front, that is, in the "zone of the army," have seven days' "permission," or furlough, every three months, the time spent in travel to and from the destination not being counted In the interior we have seven days every four months and in addition one day each month This gives no great chance to visit hospitals in other cities, but I managed to see the American Ambulance at Neuilly, and Dr Blake's hospital at Ris Orangis, as well as Dr Carrel's hospital at Compiègne, and I was fortunate to spend my seven days' "permission" in London, where I particularly enjoyed my visit to the Radium Institute An occasional "permission" for the afternoon is also obtainable when the work allows, and this gives an opportunity of running in to Paris from a town as near by as Melun

Except for a hospital some miles out of town where eye injuries were treated, no special cases, such as eye, ear, throat and nose wounds, lower jaw fractures, nervous diseases, bad burns, etc, came to Melun We also had no sick except such as came from the barracks and the neighborhood The wounded were all French, the one exception being an Australian, who had stuck his head too far out of a car window while a troop train was passing through our town He had a badly fractured skull, but finally pulled around

Our patients arrived by the sanitary trains that are designed for carrying the wounded all over France They are complete, with operating room, dressing room, facilities for cooking, and quarters for the officers and men in charge One of the finest is that under the auspices of the American Ambulance The system used is most efficient The patient stays on the same stretcher from the time he leaves the front until he arrives at the hospital of his destination We would receive a telephone call at, say, 9 30 A M that a train of wounded would stop at Melun at 11 45 A M, and discharge forty-two severely wounded and thirty sitting patients The train would roll in about on time, and, once when I timed them, in ninety seconds after the train stopped wounded were being unloaded We had four ambulances in Melun, three autos and one horse-drawn vehicle These were used for distributing the wounded as rapidly as possible The Surgeon of the Sector, when present, or, if he were away, the surgeon next in point of seniority, made the assignments of the wounded to the various hospitals

Typical French military hospitals, such as we had at Melun, are quite different from hospitals such as the American Ambulance, Dr Blake's hospital, or even Dr Carrel's hospital Our Surgeon of the Sector, Dr Rocher, after visiting at Dr Blake's, made the remark that the surgery done there wasn't war surgery but was "surgery de luxe" I think this gives a very fair idea of the difference Dr Blake's operating room—in fact the whole hospital—compares favorably with the hospitals here in



New York City At Melun we had not much more than the bare necessities, but we lacked no real essentials We certainly had no frills Our dressings were packed and sterilized in Huntley and Palmer biscuit tins, but that is no reason why they were not as sterile as if packed in Dr Blake's nickel-plated containers We had X-ray laboratories in only two hospitals, but it was easy enough to move such wounded as needed X-ray diagnosis to one of them, or to carry them there and back in an ambulance for the examination If we didn't have a full range of instruments at one hospital, it was easy enough to borrow from another, and I have no recollection of ever having lacked an essential instrument The operating tables at Hospital 12 were solid wooden benches, but at No 20, for example, we had a table which allowed Trendelenburg

As regards nurses and nursing One hospital, No 6, was under the auspices of the French Red Cross, and had several young women, including a couple of professional nurses, all of whom lived at the hospital Just incidentally, this hospital was not particularly popular with the wounded, because the rules of conduct there were more severe—no card playing for sous, for example Can you imagine the average French soldier playing cards for glory only? Hospital 20 had four or five semi-professional female nurses, who were at the hospital all of each day, and of course "Hôpital Mixte" had a few resident nurses At my hospital, No 12, we had about fifteen orderlies, all soldiers of the French Army These men lived at the hospital, but before I left their places were being taken by women The two orderlies who were to be retained were considered indispensable, one having charge of the operating room and its supplies, and the other being skilled in massage In addition to the orderlies we had six or seven women of culture and refinement who lived in Melun, who came to the hospital daily to assist with, and in fact do, most of the dressings, and also assist in the operating room Their patience, gentleness, faithfulness and excellent judgment, and their skill in doing surgical dressings cannot be too highly praised Having done this work daily since soon after the war began, the old adage that "practice makes perfect" is well exemplified

Pharmacists and chemists have ranks as officers in the Medical Corps corresponding with those of doctors One is assigned to each of the larger hospitals, or perhaps to two of the smaller ones He is responsible for the preparation of all prescriptions and solutions—Dakin's, for example—as well as for all analyses of wine, milk and other foods used in the hospitals The chemist assigned to my particular hospital was a well-known expert on poisonous gases, and I spent many an interesting hour in his laboratory, sometimes getting a sore nose and throat for my pains The idea of giving the pharmacists commissions seems to work out to good advantage, and is worthy of consideration in this country

None of the medical officers live at the hospitals Each finds a room in the neighborhood Mine, for example, cost me a franc a day, and was

as clean and neat and comfortable as could be wished, except that it had no heat. We get our meals at one of the smaller hotels or with a private family. I ate lunch and dinner with a group of officers at the Hôtel du Grand Tuiro. Six or eight of us had a private dining room and paid 2 francs, 25 centimes (about forty-five cents) per meal. Considering war prices, this was most reasonable, for the food was good, and cooked and served in the usual excellent French manner. Such days as we had time, a round of bridge after meals served to relieve the monotony of our work.

Perhaps a typical day's work at the hospital would be about as follows. We all arrived at eight o'clock. The medical staff, with the military officer in command of the hospital (who attends to purchasing and supervising the preparation of food, paying the soldiers, etc.), first make the rounds of the hospital. Every wounded or sick man is seen, and the entire hospital is visited. The food is examined, and care is taken to see that everything is shipshape. After this the surgical dressings are done, invariably in dressing rooms fitted for the purpose, except when it is dangerous or too painful to move the wounded man from his cot. There were three divisions and three dressing rooms at Hospital 12, each of the medical officers looking after the dressings on one of the three floors, although, as surgeon, I was called to see anything out of the ordinary. The dressings, if not finished by noon, were continued after lunch. X-ray examinations at "Hôpital Mixte," or No. 20, perhaps took up part of the afternoon, while the making out of reports, etc., filled the balance of the time before dinner. It was usually late when dinner was finished and bed was welcome at a reasonable hour. Of course operations from two or three to five or six days a week interfere with this schedule. Not infrequently, when the wounded were arriving twice a week, the entire day would be spent in the operating room.

The giving of anæsthetics usually fell to a nurse or orderly, and frequently was poorly done. For general anæsthesia chloroform commonly was the choice, ether very rarely being used. Chloride of ethyl was used as a general anæsthetic for very short operations, such as the opening of abscesses. Spinal anæsthesia with novocaine or stovaine was a favorite with Dr. Rochei, and with one or two exceptions it was well borne. For local anæsthesia, ethyl chloride or cocaine was usually employed. Occasionally, when a particularly long operation was to be done, or when the wounded man had a bad heart or was not in good general condition, one of the surgeons gave the anæsthetic.

In some respects the operative technic varies considerably from American methods. The use of thick rubber gloves with short fingers and long wrists is almost universal, and it was not long before I became used to them, and now I am rather sorry to be obliged to go back to the thin tight gloves. The thick gloves are much more comfortable and of course are not easily punctured, and the tactile sense is not nearly so much interfered with as one might expect. I never saw a needle holder

in a French hospital. The Reverdin or Doyen needle (corresponding to our perineal needle) is always used, except for special work, such as nerve suturing. These two styles of needles are similar, but one is arranged to thread by opening the eye of the needle by moving a thumb attachment in the handle. An ordinary sewing needle with fine linen or silk thread was used to suture nerves and while using this it was customary to put on a thimble over the glove. Plain catgut and silkworm gut are the common ligature and suture materials. The latter is always dyed a brilliant color. Unabsorbable buried sutures are rarely used except for nerve or intestinal work. Chromicized catgut I never saw. Clips are often used for the skin. Hand sterilization consists of gentle brushing with sterile soap and a sterile brush in a basin of sterile water for six or eight minutes. The hands are then dried on a sterile towel and after rinsing with ether are soaked thoroughly in 95 per cent alcohol to which has been added a little iodine, just enough to stain the hands yellow. Frequent hand preparation by this method did not affect the usual smoothness of the skin.

I think the one point in the technic that I would be most inclined to criticize is that ligatures and sutures are often tied too tightly. Small gauze sponges are never used, compresses taking their places. Whenever possible the operator and his assistants sit down on stools of the proper height. When it is necessary to spend the entire day in the operating room, this makes quite a difference. Patients are tied on the operating table, and one never sees the surgeon leaning on one leg with an assistant holding the other, while nurses try to keep the rest of the patient on the table.

The preparation of the field of operation consists of thoroughly washing with soap and water and shaving, some hours before the operation. No dressing is then used unless it be perhaps ordinary bandaging. After anesthesia is complete, the entire field is painted dark brown with tincture of iodine. If discharge is present, it is washed away with ether before the iodine is applied. For quick sterilization of clean instruments and basins, flaming, either with a Bunsen burner or with the aid of 95 per cent alcohol set on fire, is much used. At Dr. Carrel's hospital I saw plans for a heated operating table, ordinary incandescent lamps being used for the purpose. He also had plans for a heated cover for an operating table. Both of these are meant to prevent the undue loss of body heat and to combat shock, and seem quite practical. While operating all X-ray pictures of the case are pinned up in a window where they can be seen at a glance.

The great majority of wounds are from fragments of shell. Bullet wounds are next most common, while hand-grenade wounds, burns, and bayonet wounds follow in the order mentioned. Of the last named I saw but one case. Multiple wounds are the rule. A single wound from a shell fragment is exceptional. Thirty, forty or fifty wounds from the

explosion of a shell close by are not particularly rare. I remember the case of a stretcher-bearer who was helping to carry a wounded officer near Verdun. A German shell of good size exploded close by, killing the wounded officer, the other stretcher-bearer and two medical officers who were walking with them. The man who escaped with his life came to the hospital literally covered with wounds on one-half of his body, there were well over a hundred. We picked out pieces of shell, clothing, newspaper and gravel at each dressing for days afterwards. He was suffering pretty severely from shell shock and was almost entirely deaf when he was admitted, but he had no one serious wound. An abscess in the cheek on the opposite side was a puzzling complication, until it was figured out that he had had his mouth open when the shell exploded and a piece of gravel had entered the cheek through his mouth. Inside of a month he was ready for the furlough which is granted all seriously wounded men before they return to the front.

"Shell shock" was often seen in soldiers who were wounded by a shell that exploded close to them. I am told that this kills instantly in some cases, dead being found without any external wound. It varies in degree, of course, but the average case clears up in a few days and evidently leaves no bad results. Deafness, with or without the shell shock, usually clears up as promptly.

The two great bugbears for the surgeons are secondary hemorrhage and secondary infection. Judging from what I have been told by various surgeons we were fortunate in having less than an average share of the former. These hemorrhages may occur in a wound or at some distance from it. If a large vessel is eaten through, death often occurs before anything can be done. There seem to be two factors in its etiology. One—and the most important—is infection, but the trauma, apart from the infection, seems often to weaken the blood-vessel wall. The distance along which the artery may be affected is often surprising. The first hemorrhage of this kind that I tried to stop was from the radial artery, and the bleeding point was about an inch and one-half from the wrist. I followed that vessel up nearly to the brachial before I could find a portion sufficiently strong to bear a ligature. I found afterwards that this experience was not particularly uncommon.

Secondary infection is extremely common. Practically every wound that we saw was infected before it reached our hospital, and this is the same almost throughout France. With one or more infected wounds, perhaps not draining as freely as they might from every angle and corner (although the attempt had always been made to open and clean them thoroughly as soon as they reached the ambulance), it is not difficult to understand how secondary infection may develop. A rise in temperature, not necessarily large, was usually the first sign. Pain was next, and other signs, as redness, swelling and tenderness in a new area, promptly followed. Early and free incision and good drainage is the only method of treatment, although occasionally—I can remember per-

haps four or five cases—a continuous hot saline bath with the proper posture would forestall operation. I have since thought that possibly these cases escaped operation because the new abscess broke into the old wound, rather than because of any direct resolution of the newly-infected area.

While speaking of secondary infection, it always appeared to me that the remote severe infections of various organs—acute nephritis, endocarditis, arthritis, appendicitis, etc.—were extremely rare considering the universal wound infection, forming a focus of infection, often severe and large in extent. I remember but two cases of acute nephritis. Appendicitis was less rare and I suppose may often have been due to hæmatogenous infection.

I saw but one case of tetanus while in France. This was an elderly civilian who had cut his hand with a hatchet and had neglected the wound. He died after a very brief illness. Every wounded soldier receives a dose of antitetanic serum as soon as possible after he is hit, and a second dose a few days later. I have seen some startling rashes and two or three cases of very high temperature ( $107\frac{1}{2}$  degrees in one case) but no permanent ill results.

The most frequent operation was removal of shell fragments or other foreign bodies, and the next most common was the opening up of secondary infection, while the next in order of frequency was the operation for osteomyelitis. When long-continued infection included bony structure, as it often did, one of two conditions was frequently observed affecting the bone, either it softened and became spongy, indicating more or less decalcification, or excessive callus formed, which, on occasion, became extremely hard. The experience of the French surgeons teaches that the only cure consists in the free removal of the abnormal bone tissue. My first impression was that the work done often was too radical, but later I became convinced that this procedure was right.

A word regarding the removal of bullets, shell fragments and other foreign bodies. At first I was much surprised at the difficulty of these operations. The first and greatest obstacle was the finding of the foreign body. All kinds of schemes are used. The X-ray will show metallic bodies well, but even while operating directly under the rays it is often far from easy to locate the foreign body. The depth is not indicated without turning the affected part, and until we received an apparatus to use in a lighted room it was necessary alternately to lighten and darken the room. The method of taking radiographs in several positions and determining the exact location of the metallic body by means of various lines also aided, but one serious drawback remained—bits of gravel, clothing, or other non-metallic bodies were sometimes overlooked. The vibrator was the most useful aid for finding metallic fragments not too deeply embedded. This was simply an electromagnet arranged to act with a make-and-break current, causing the shell fragment to vibrate so that it could be located by the sense of touch. The

sense of hearing was employed by another apparatus. This was so arranged that when a tip, worn on the finger inside of the glove and connected to a battery, was brought near a metal fragment the ear piece buzzed. One great drawback with both of these latter methods was the annoyance caused by the necessity of removing metal instruments from the field of operation while they were in use. Another was that lead or brass foreign bodies did not indicate their presence, because not magnetic. We often said in jest that if some one would only invent an apparatus by which we could taste the foreign body we could use all of our senses, because sight, hearing, touch and sometimes even smell had been utilized. Another thing that seemed peculiar to me at first was the difficulty of removing shell fragments even after they were located. If they had rested in the tissue any length of time they were more or less embedded in scar tissue and had literally to be dissected out. When this occurred in the centre of the psoas muscle, for example, it meant a new wound of considerable size. Of course the moral of this is the prompt cleaning of all wounds, including the removal of all foreign bodies, and this is being done to a greater and greater extent in the hospitals close to the front line.

Many of the problems in surgery which came up for solution had numerous puzzling features—questions which no text-book could answer except in the most general way. For example. A soldier came into the hospital two weeks after he had been wounded by a shell that had exploded behind him. Besides several minor wounds he had one serious injury that included a ragged wound of the soft parts and a comminuted fracture of the ischium. Naturally he had not lain on his back since he had been wounded. We opened up the wound still more freely than had been done at the ambulance, removed several small pieces of bone, packed the wound lightly with gauze saturated in Dakin solution and arranged a hammock or sling so that he could lie on his back without pressure on the affected area. By the time he was ready to be sent further south the wound had healed to a considerable extent, but he had developed a cough and we feared he would become tubercular. As so often happened, I could not follow the case through, because room was needed in the hospital and the convalescent, or easily moved patients, had to be sent farther away from the front. Another case was a soldier who had been shot through the abdomen by a rifle bullet in August, 1914. He came into my hospital two years later, in fair condition except for a small ventral hernia and a small sinus over the hip, about three inches below the crest of the left ilium. Without warning his temperature jumped to 105°, and he had symptoms of beginning intestinal obstruction. Perhaps unwisely, I decided to delay operation and the temperature gradually fell. Forty-eight hours later, under local anæsthesia, I made an artificial anus at the site of the hernia just outside of the left rectus muscle. His temperature then rapidly fell to normal and we were able to do a further operation in the course of a couple of weeks. The sinus, before mentioned,

was found to connect with an abscess cavity holding three or four ounces and lying inside of the pelvis but outside of the peritoneum. This cavity connected with a loop of the colon—at quite a distance from the artificial anus. His condition continued to improve upon free drainage of this cavity, but before we could do the necessary intestinal resection he too was transferred to a hospital farther south.

Some of the minor methods and appliances are quite different from those used in America, and appealed to me as being well thought out and worthy of wider use. Much skill was shown in the application of plaster casts for compound fractures that need daily dressings. Under anæsthesia, if necessary, the limb was put in the desired position and the cast was applied in two parts, one above and one below the wound. When about half on, previously prepared iron wire handles were embedded in the cast so that when covered with the plaster bandage they held the two parts of the cast firmly in one piece, at the same time being so bent that they were well away from the wound. They also formed most convenient handles for moving the injured limb. Just before the cast was dry it was coated with talcum powder, well rubbed in. This makes a smooth, almost glassy surface, which is readily washed. In addition the date of application is always written on the cast.

A very ingenious method of applying a cast for either simple or compound fracture of the humerus was noted. In a sitting posture, with or without anæsthesia, the patient has a bandage tied around the forearm close to the elbow, the forearm being at right angles to the arm. A similar bandage is applied at the shoulder. Assistants make sufficient traction on each bandage to overcome the shortening, then, with the bone fragments held in the proper position, the plaster is applied from the shoulder to the elbow, a window being left, or made afterward, if there is an open wound. When carefully applied and padded this holds the humerus in perfect position without a complicated weight and pulley apparatus. Traction must be maintained until the plaster has hardened, and it must be understood that the cast is long enough to include the elbow-joint and fit snugly against the shoulder. A case in point is as follows. A civilian, well along in the seventies, was run over by an automobile, suffering, besides other wounds, a compound fracture of the middle of the right humerus. Street dirt was thoroughly ground into the wound, which promptly became infected. Although his general condition was far from favorable (he was delirious and had considerable fever), a cast was applied in the manner mentioned, without anæsthesia. The reduction was well maintained, the infection cleared up under the use of Dakin solution and his convalescence was as smooth as could be desired. One obvious advantage of this apparatus is that the patient need not be confined to the bed, a great consideration in a case such as this.

The antiseptics used in dressing open wounds. For cleansing purposes, both in the wound and of the area surrounding, gasoline to which has been added just enough iodine to make it a bright pink is a most

satisfactory solution. It causes little or no pain, even in an open wound. Probably every antiseptic known to man has been employed to moisten the dressings used in packing wounds, and personally I am satisfied that carefully prepared Dakin solution is the most efficient. I might say that to get results comparable with those obtained at Dr. Carrel's hospital at Compiègne, the utmost care is needed, particularly in the microscopical examination of the wound secretions. This is a pretty difficult matter in a town such as Melun, where we had six hospitals and one overworked bacteriologist. If I remember rightly I was told at Dr. Carrel's hospital that nurses were easily trained for such work, but we did not have even graduate nurses, or, for that matter, a sufficient number of microscopes. Dakin solution is most excellent for wounds, even when not used by Carrel's method. Wet dressings are covered with oil silk. This, when properly applied, will keep dressings moist for many hours.

One more minor appliance is worthy of mention. It consists of a rope hanging from the ceiling above each cot and reaching to within eighteen inches of the patient's chest, it terminates in a wooden handle some four or five inches long. Unless a man is wounded in both arms, which is rare, he is able to raise and shift himself surprisingly well. As the orderlies have but little time for such minor attentions as arranging pillows or shifting patients to a more comfortable position, this simple appliance adds greatly to the comfort of the wounded.

As stated before, burns—that is, serious burns—are treated at special hospitals. I wanted to visit de Santfort's Hospital at Issy-les-Moulineaux to see his work along this line, but I could not find the time. But I have talked to men who went there thoroughly skeptical and came away equally thoroughly convinced. They tell me the results from the use of his "Ambrine" are simply incredible, unless one sees them for himself. "Ambrine" is a secret combination of certain waxes with paraffin. It is applied hot to the whole burned surface. One of the most remarkable effects is that it stops pain at once. The dressings are changed daily and healing takes place rapidly, many times with little or no appreciable scar.

At one of the Russian hospitals in France a solution of soap is being used in the treatment of wounds with remarkably good results. This is another place I wanted to visit, but again I had to accept second-hand reports.

I visited both the London and the Paris Radium Institute, and was especially impressed with the work that the physicians of the latter—Dr. Degrais in particular—are doing on war wounds with radium. The most thoroughly satisfactory cases were those treated for vicious scars and the deformities caused by them. Some "before and after" pictures spoke eloquently for the aid that radium can give.

In closing, let me emphasize the smooth-running system that France has devised for her Medical Corps in caring for the wounded and sick of a tremendous army. Pitifully unprepared when the war broke out, she



has met the many difficult problems in a straightforward manner and now stands as an example of what a united country with a single purpose can accomplish. Winning this war has become the intimate personal business of every French citizen and that is the spirit that sees and gains only victory.

In entering upon this greatest of wars, I feel that we can learn much from our sister republic, and among the lessons that are not least important are those of the organization, equipment and smooth working of the Medical Corps.

# THE X-RAY IN WAR SURGERY AND ITS RELATION TO THE REMOVAL OF FOREIGN BODIES

SPECIAL REFERENCE TO OPERATING WITH SYNCHRONOUS ASSISTANCE OF THE FLUOROSCOPE

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FOR convenience sake we have divided the matter of this article into three divisions I Establishing the presence of a foreign body II Establishing its location III Removing the foreign body

I The present war has emphasized the great value of the fluoroscope as a diagnostic agent and its superiority in general over the plate method With a little training, with a tube slightly harder than usually used for fluoroscopic purposes, and with a small diaphragm, minute metal splinters are seen in the extremities and pea-size fragments are seen in the abdomen and skull Holzkecht of Vienna goes so far as to claim that barley-corn-size splinters in the cranium come within the practical limits of the fluoroscope In our cases over 90 per cent of lodged bullets were observed with the fluoroscope and less than 10 per cent were discovered by means of plates or first observed when discharged with the secretions into the dressings

Unless we use the fluorescent screen we are very likely to overlook bullets because large areas must be searched Bullets are not always where one expects to find them A bullet canal of one metre in length is not at all unusual, nor is it a rare occurrence to find a bullet lodged at some point of the body, to reach which, in a direct line from its entrance wound, it would have had to pierce several vital organs For example, we had one case with an entrance wound just to the left of the sternum at the fifth interspace The patient gave no sign nor symptom other than vague general pain in the left side in breathing and a rise in temperature which, however, soon abated after the bullet was removed from under the left scapula In cases like this, bullets would frequently be overlooked if a plate or two were depended upon for diagnosis The number of plates required to cover the areas where a bullet might be would not only occasion a great amount of needless labor, but also a large expense and a waste of time Occasionally where a diagnosis must be made while a cast or splint is worn, a plate must be used

It is well in taking photographs, as also in examining with the fluoroscope, to observe the part in more than one direction, because a small

projectile covered by a large heavy bone can very easily be overlooked. Luckily, however, any foreign body which is so small as to be overlooked by the fluoroscope will not often produce symptoms.

Due to the expensiveness of plates, most of the hospitals in Vienna have attempted to substitute paper, similar to that used in making copies, but stiffer. The technic is the same as with plates, except that a harder tube and a longer exposure are necessary and that a screen must always be used. The exposure is made with the emulsion side of the paper against the screen, sending the rays first through the paper. The

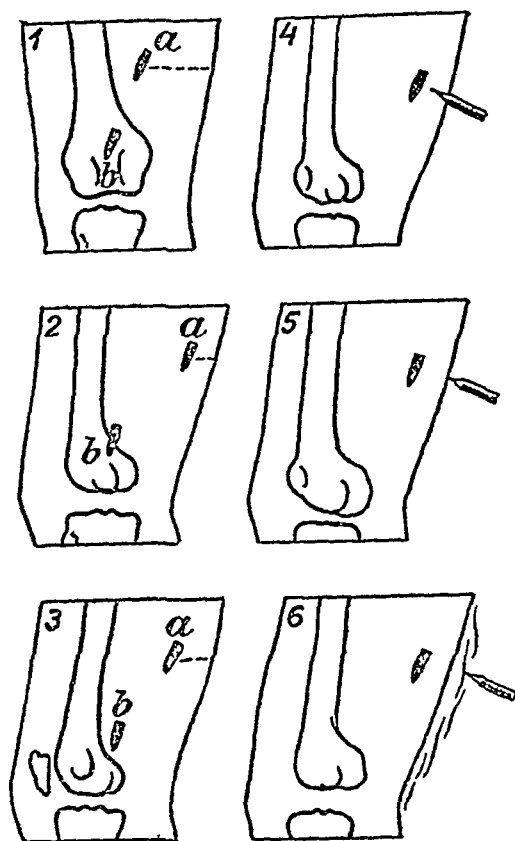


FIG. 1—1 and 2, rotation until bullet *a* lies in the "shortest skin foreign-body line", 3, rotation until *b* lies in longest bone foreign-body line, 4 and 5, marking site of bullet by sliding pencil about limb until whole pencil is outside of tissue shadow, 6, same on bandage (Holzknecht *Munch med Woch*, 1914, No 45)

resulting pictures are good enough for finding coarse metal fragments. Paper negatives should not be used for detail work.

II Much more difficult than the determination of the presence of the foreign body is to determine its position. Here again the fluoroscope is of inestimable value. A very simple method for making rough localizations, especially in the extremities, is simply to fluoroscope the part in as nearly as possible perpendicular directions, marking the projections of the foreign body on the skin with blue pencil. Another common method is to rotate the patient under the fluoroscope, keeping the distance from the bullet to the skin in mind, and ascertaining where this is the smallest. This distance is for all practical purposes the depth of the bullet. Then

with a skin pencil the site of the bullet is indicated by encircling the skin with the pencil held parallel to the screen. The pencil point marks the site of the bullet when the whole pencil is outside of the shadow of the soft parts (Fig 1). This method can also be used to determine the distance of the bullet from the skeleton as well. Here the point where the bullet is farthest from the bone is chosen and marked as the near point. Skeleton localization is a good method, especially when the soft tissues are very swollen or œdematous or when the foreign body is lodged near the bone.

In all localization, either by fluoroscope or plate, a good axiom to keep in mind is that a foreign body lies outside of a hollow cavity or bone

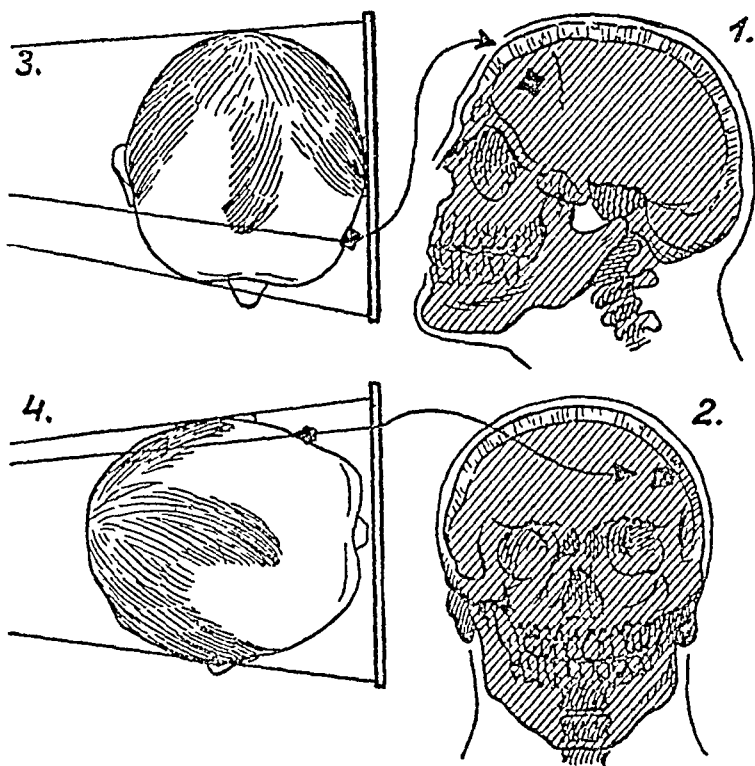


FIG 2—1 and 2, X-ray pictures of a foreign body which in spite of the two pictures seems to lie within the cranial cavity, 3 and 4, the foreign body is stuck to the skin with adhesive. Its projection inside of the skull is only apparent (Holzknecht *Münch med Woch*, 1914, No 45)

when on the screen or plate at any one time it appears outside, but inside the cavity or bone only when at no time whatsoever during the rotation is it seen outside. Dr Holzknicht, of Vienna, has especially emphasized this.

In his article in the *Munchener medizinische Wochenschrift* for 1914, No 45, Holzknicht has ingeniously demonstrated the fallacy of the common way of taking pictures in two parallel directions and relying upon this to localize the bullet. He showed pictures of a bullet which apparently seemed to be deeply lodged in the brain, when in reality the bullet was held to the temple by means of adhesive strips (Fig 2).

When the above described methods of localization have not sufficed we have made use of one of two other methods.

The first of these is that of Holzknicht, Sommer and Mayer, as de-

scribed in the *Munchener medizinische Wochenschrift*, 1916, No 14, and is as follows

With the diaphragm of the tube as small as possible the tube is set under the foreign body and its image noted on the fluorescent screen which is held above the patient, perpendicular to the X-ray, on a standard, and the site of bullet marked on the skin. The diaphragm is thrown as widely open as possible and the tube moved in one direction until the foreign body just disappears. Its projection is marked on the screen. The same step is repeated, moving the tube in the opposite direction, and again a mark is made on the screen. The distance between the two marks is read off on a scale and the result equals the distance (in centimetres) the projectile lies under the under surface of the screen, at point marked. The scale is easily constructed once for all, for any given table, tube or standard, by following the same procedure with a metal body at the end of a 10 cm long rod which is attached with adhesive perpendicular to the under surface of the screen. The method is very satisfactory and gives for all practical purposes an exact figure, can be carried out on any X-ray machine and requires no special instruments. It is easily, quickly and cheaply accomplished. The other method we have used is that of Dr Kautzky. The method requires a special apparatus, a plate as well as a fluoroscope. We prefer the more simple method of Dr Holzknecht.

The method of localizing a bullet by means of the stereoscopic tube has been used by some with good results. We cannot quote from personal experience. To give an account of the innumerable localization devices would be a long and difficult task. Dr Wachtel, of Wien, states that before the war there were already over one hundred different modifications. Since the war the number has greatly increased. All fail in one or more practical points. They are either too expensive or too clumsy, or too complicated or too inaccurate, etc. The object of localizing a bullet is not only for diagnostic purposes, but in the great majority of cases to assist the surgeon in its removal. All localization devices fail in this last-mentioned duty for one or all of several reasons. That this failure is a real one will be acknowledged by any surgeon who has attempted to remove even a small number of lodged bullets. Objects whose localization has been such that their removal ought apparently to be a simple matter have often required several hours of searching until found, or occasionally until given up in despair.

Fig 3 shows a case where a competent surgeon searched forty-five minutes until the bullet was found, although, judging from the X-ray picture, it seemed a very simple matter. Again, large wounds must be made so that the tissues can be more readily investigated or the tissues themselves badly mauled before the elusive fragment is discovered. The reasons for this are evident. Every change in position of the patient changes the position of the bullet. A bullet lying 3 cm below the skin

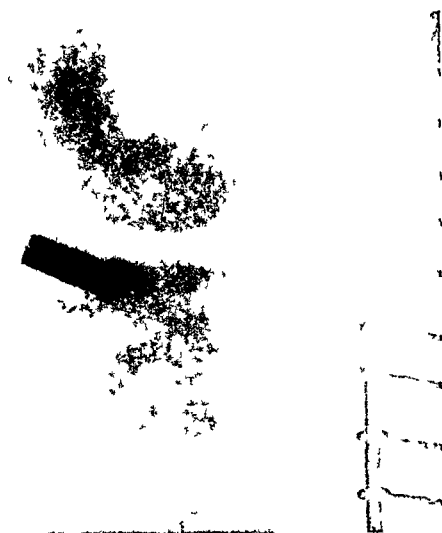


FIG 3 —Bullet apparently easy of removal eluded search for an hour until found with cryptoscope

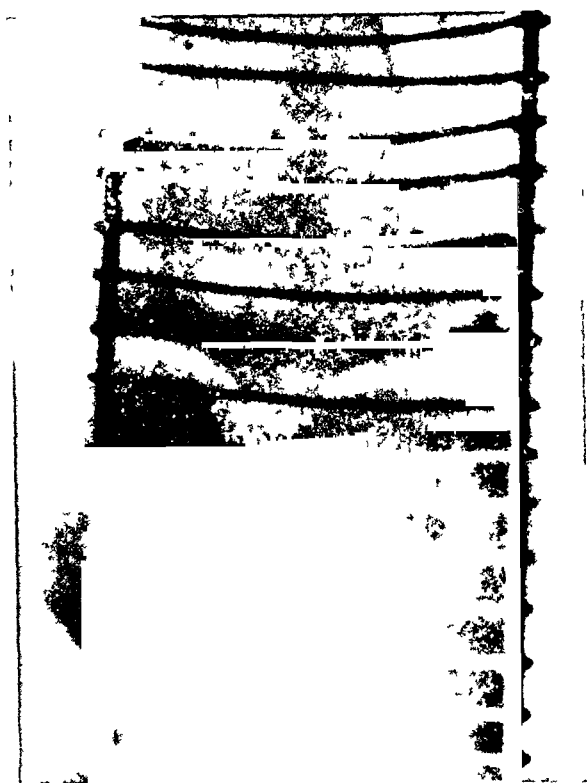


FIG 4 —Bullet apparently behind femur In reality anterior to femur



FIG 5 —Cryptoscope with screen closed



FIG 6 —Cryptoscope with fluorescent screen raised



FIG 7 —Bettmar cryptoscope

at the time of the localization may at operation be found twice as deep, because the position of the patient is only apparently the same as when the bullet was localized. A muscle relaxed during an anæsthesia will change the position of a lodged bullet many centimetres from the position which it held while the muscle was in good tone as is the case in contraction. A bullet may follow along the course of tissue planes or down a fistulous tract, moving several centimetres in a few days. Fig 4 shows a picture of a bullet located posterior to the femur, but which, while operating under Rontgen guidance several days later, was discovered anterior to the femur. Furthermore, as soon as the record is made the locating point in the skin is disturbed, retraction further disturbs relations. It is a great temptation to follow natural lines of cleavage and when these lie in practically the same plane as the line of approach to the bullet, it is very difficult not to be misled. A fragment becomes quickly encapsulated with firm fibrous bands so that it resembles the rest of the scar, and also so that it evades the knife.

III *The Actual Removal of Foreign Bodies*—The difficulties just mentioned, which are associated with the removal of bullets, are so real and so often present that we have adopted the method of assisting ourselves during the operation by synchronous fluoroscopic orientation. The idea is not new but originated almost immediately after the introduction of the Rontgen apparatus. Grashey, in 1904, constructed a monocular fluoroscope and thus originated the method of daylight operation with fluoroscopic assistance. Much credit is due Holzknacht, who by means of his elaborate machine placed this method of operating on a firm practical basis, and who in conjunction with many of the prominent Vienna surgeons, notably von Eiselsberg, has had extremely gratifying results. We have constructed a very simple and cheap portable operating fluoroscope with which we can accomplish the same results. Our operating cryptoscope, as it has been termed here in Vienna, is simply a light wood or card-board box, or, to be more exact, a truncated pyramid, which is held over the surgeon's eyes by means of two head straps. The base of the pyramid, which is 18 cm by 13 cm in size, is composed of a fluorescent screen, is on a hinge and, when released from a catch by pressure on a button, flies open under the influence of a spring. A piece of lead glass is inserted into the box to act as a shield. When the base is pulled down (Fig 6) into position the surgeon is looking into a light-tight box, or, if in line with the X-rays, upon a fluorescent screen.

Our method of procedure for removing lodged bullets is as follows. The presence of the bullet is determined, its approximate position has also been ascertained by one of the methods mentioned. The path of attack has been planned, the skin area prepared in the usual manner and the patient placed on the X-ray table as if on an operating table. A tube (we use the same tube which we use for fluoroscopic purposes) is in the under table stage. The field of operation is lighted by daylight or strong artificial light. After the surgeon and assistants are sterile, the



cryptoscope covered with a sterile cloth is placed over the eyes of one of the assistants. He closes the screen, or base of the apparatus, the X-ray machine is set in function and the assistant now localizes the bullet as he would with the aid of the usual fluorescent screen in a dark room, by means of a metal instrument. The surgeon makes a small incision, working down to the bullet, being guided by the assistant, who is watching the operation on the fluoroscope and who guides him verbally or by means of a pointer down to the bullet. It will often happen that after the incision has been made the assistant himself by blunt dissection with a clamp can separate the tissues and grasp the bullet. He sees the silhouetted clamp approach the metal shadow, he sees this shadow move with every little impulse of the clamp when he has reached it. As he opens the clamp slowly he can see the jaws stretch over the bullet, he can see that he has grasped the bullet. He then releases the screen and in full light very carefully, so as not to cause any injury to neighboring tissues, he withdraws the bullet. Great care must be taken in doing this. If the bullet does not come away easily it is much better to prepare down to it, loosen its adhesions and make sure that, although very carefully applied and under direct scrutiny of assistant by means of the fluoroscope, the clamp has not included besides the projectile some tissue structure. Often in simple cases the surgeon himself wears the cryptoscope, operating with the screen released and orientating himself from time to time by closing the same and looking at the bullet with the fluoroscope. Most tubes will not stand the strain of continuous use throughout the operation, our tubes among them. In this case we use the fluoroscope only at intervals to guide the surgeon back to the right path or to confirm his progress.

In order to shield ourselves from the injurious effects of the X-ray, a 1 mm aluminum filter is placed over the diaphragm. Furthermore, the diaphragm is narrowed so that the whole shaft of light falls within the margins of the screen. We operate the diaphragm with our knees by means of stirrups fitted on the handles. Of course where good tubes are used and the means permit, the X-ray table can be placed in the operating room, and the current conducted by means of cables.

The results have been striking in many cases. Bullets for which a long search has been made, often repeated searches, have been quickly removed when the search was aided by the cryptoscope. Time and again the surgeon was unable to find the bullet until the roentgenologist pointed to its location directly in the walls of the wound, or under a retractor or a tissue sheath. The average time for a foreign body operation has been reduced fifty or seventy-five per cent. Tissues are not needlessly traumatized nor are large wounds made where small ones suffice. We have also used this method with similar success in a few cases of needles in the hands of some of our hospital servants and warmly recommend its use for such cases.

# A METHOD OF PRECISION FOR THE REMOVAL OF NEEDLES IN THE HAND. THE USE OF THE MICROPHONE\*

BY KENNETH BULKLEY, M D

OF NEW YORK

ASSOCIATE VISITING SURGEON, BELLEVUE HOSPITAL

(From the Cornell Surgical Division, Bellevue Hospital)

THROUGH the kindness of the Directors of the four Surgical Services of Bellevue Hospital, I have been able to collect from the Hospital records 72 cases of needles in the hand or foot. It is the experience gained from a study of these and my own cases which I wish to report at this time.

In 54 (or 75 per cent) of the cases the needle was in the hand, and in 18 (or 25 per cent) it was in the foot.

Needles in the feet most commonly gain access to the sole while the individual is walking barefoot. In this series they have been encountered with equal frequency in children and adults. I was previously under the impression that they occurred mainly in children. In the hand there are three main ways in which the accident occurs. The most common is in washing clothes, 53 per cent of the hand cases occurring in this way. Next in frequency is in scrubbing a floor or in some similar motion in which the hand is usually pierced by the eye end of the needle. The third is by machine needles, in which the machine is started while the operator's hand is still within the range of motion of the needle.

Curiously enough, it is rather unusual for an infection of any severity to develop following the implantation of a needle. Relatively few abscesses develop and the superficial cellulitis, if it occurs, is usually not severe and is self limited.

In a finger or thumb pulp, either a central fragment of a machine needle or a pointed end of a hand sewing needle is usually found. It is uncommon to find a needle anywhere in the finger except in the pulp. The majority of needles enter the hand on the palmar aspect within an inch of the os magnum, and assume their final position almost immediately, this position being determined largely by the direction of motion of the hand at the time of impact and the immediate subsequent attempt, usually made by the patient but only too often by the physician, at removal. Thus they may be found in the thenar or hypothenar eminence, in the midpalm, in the tissues in front of the wrist, or in the musculotendinous mass just above the wrist.

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\* Read before the Surgical Section of the New York Academy of Medicine, February 2, 1917

The distribution in the hand cases in this series was approximately as follows

Thumb or finger	20 per cent
Thenar eminence	44 per cent
Hypothenar eminence	10 per cent
Front of wrist	10 per cent
Remainder of palm	10 per cent
Dorsum of hand	4 per cent

Not all embedded hand or foot needles give rise to symptoms. We have seen cases which did not know of the presence of a foreign body until an X-ray picture for some other condition was taken. A letter was recently received from a patient who has carried a long needle fragment high in the arch of the foot for five years without symptoms. And not long ago I removed the eye end of a needle which had lain along the flexor surface of the index metacarpal for nearly nine years, only shortly before operation giving rise to symptoms.

But sooner or later a majority of these patients do have discomfort due to the presence of the foreign body. The symptoms are often slight but very definite and persistent, and frequently do not make their appearance until some time has elapsed since the injury. Pain on pressure, so that the firm grasping of an object in the palm is uncomfortable or impossible, is the symptom most commonly encountered. Limitation of flexion or extension of a finger is at times seen, and almost invariably means a palmar needle piercing at some point a tendon or its sheath. Needles in the thenar eminence seldom give rise to this symptom.

Patients apply for the removal of these needles in two groups. The first group includes those who largely from fear of immediate or remote trouble apply for removal at the earliest possible moment after injury. In the second group I place those patients who, because of the development of symptoms at a later date, apply for the removal of the needle. I believe that the majority of patients in the first group, if the needle is not removed, eventually become members of the second group.

Numerous devices have been suggested for the localization and removal of these needles. For accurate localization, the triangulation X-ray photographs and the stereoscopic radiograph are of the greatest assistance. The ordinary method of surface marking has been greatly improved by the checker-board marking described in 1913 by Dr Brown.

But the greatest difficulty has always seemed to me to be not so much in the localization of the needle *before* incision, as in its recognition at time of operation. If, on incision, the needle comes at once into view, the problem is solved. But embedded needles are frequently buried in the muscular thenar eminence, lie longitudinally in a lumbrical muscle or flexor tendon, or hide in the most adept manner in one of the interossei. To *see* a needle so hidden means a large incision, wide

## REMOVAL OF NEEDLES IN THE HAND

retraction, and often considerable injury to muscle or tendon, all these factors tending to lengthen the time of operation and to enhance the possibility of infection. To be always able to *feel* a needle with the examining finger partakes of the supernatural. I question either the memory or the experience of the man who states that he has never failed to find a needle by the ordinary dissection method. Of course, one may, if fortunate, have the opportunity to work under the guidance of the fluoroscope but this is not always available.

To show that the difficulty of finding these needles is not exaggerated, I have analyzed the records of 72 hospital cases. In 8 cases, for one reason or another, no attempt was made to find the needle. In the remaining cases operated on by the ordinary dissection method, the results are instructive. These are not dispensary patients, but patients admitted to the wards of the hospital. The results are as follows. The needle was found on the first attempt in only 47 per cent of the cases, 17 per cent with local and 30 per cent with general anaesthesia. The remaining 53 per cent, in which more than one exploration was done, divide themselves as follows. In 13 per cent (9 per cent with local and 4 per cent with general anaesthesia), one attempt only was made and the needle not found. In 24 per cent the needle was found on the second attempt, all under general anaesthesia, of these 16 per cent had been searched for previously under local and 8 per cent under general anaesthesia. In 10 per cent the needle was searched for twice and not found, all of this group having the benefit of general anaesthesia at least once. In 5 per cent the needle was found only on the third attempt. And one patient was sufficiently docile to permit of five attempts at removal, two under local and three under general anaesthesia, before the needle was found.

These figures are rather disconcerting but nevertheless correct, as far as can be determined, for this series of cases. And they do not sustain the argument that to find and remove a needle is easy. I have seen no figures from other clinics and consequently cannot judge whether this figure is above or below the general average. But 53 per cent of primary failures probably represents the general experience.

In looking about for some way of improving these figures, my attention was attracted to the microphone. This was first suggested in 1883 by Alexander Graham Bell and has since been used with varying success by a number of workers. It is really very simple, but like all things electrical requires some care and attention and also some electrical judgment.

As the theory of the apparatus has been described by the writer in a previous paper,<sup>1</sup> it need not be entered into here.

Fig. 1 illustrates the component parts of the instrument. The microphone now used has a combined resistance of 3000 ohms, thus being far more sensitive

than the commercial telephone receiver which has a resistance of 75 ohms. The wound electrode wire is insulated with rubber of sufficient purity to withstand sterilization. The rectal or mouth electrode is made of hard carbon and is moistened with water before insertion.

Fig 2 illustrates the instruments commonly used. For removal of embedded needles an ear knife, a fine mosquito forceps, and an insulated needle, about size No 5, only are necessary. The other instruments shown have proved useful for embedded metallic fragments other than needles. It will be noted that all instruments are provided with suitable attachment for electrical connection. I am at present using a needle insulated, except at its extreme tip, by Japanning.

Fig 3 represents the instrument in use. No current of any sort is used other than that developed between the carbon electrode and the embedded metallic foreign body. As contact is better in a dry than in a bloody field, I have been in the habit of using a tourniquet. Local or general anæsthesia may be used, preferably the latter. The arrangement of wires is especially to be noted. Leading from the head piece is seen a single wire extending down the operator's back. At the right hip this divides into two, each provided with a connector, and these are separately pinned so that no contact between them is possible. This part of the apparatus is adjusted before the hands are sterilized. To one of these connectors is attached the wire leading to the carbon electrode—in Fig 3 shown in the patient's mouth. To the other is attached an insulated wire which has been sterilized with the instruments. It is my custom, after careful localization with the X-ray, to make a half-inch incision and with a sharp insulated needle in circuit puncture the tissues at the desired point until electric contact with the embedded metallic foreign body is obtained. This is indicated by an unpleasant clicking sound heard in the microphone. There is a click on the make, another on the break of the current, and an irregular grating sound if the exploring instrument be rubbed along the foreign body. The exploring needle is then replaced by a small ear knife, the tract to the object sought enlarged, and contact again obtained. The knife is then replaced by fine mosquito forceps, contact again obtained, the needle grasped, and then removed either through the original incision or through a puncture point elsewhere. With this technic it is unusual to feel either with a finger or the examining instrument or to see a needle until it has been removed. The sense of hearing is alone employed. Contact has been obtained many times in less than ten seconds.

I have had the opportunity of using the microphone on 33 cases of embedded metallic foreign bodies, 25 of which have been needles. Of these 20 were in the hand, 1 in the foot, 2 in the capsule of the knee-joint, and 2 in the back. In over a third of these cases one or more previous attempts at removal by the ordinary dissection method had been made. The results are interesting and to me have been instructive, as I feel that I have learned from my errors. In 2 cases I have had difficulty. Fig 4 shows a small needle fragment over the head of the middle metacarpal in the first of these two cases. The picture was taken two days before my attempt at removal. At operation I could obtain no contact and gave up the attempt. Fig 5 shows why no contact

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<sup>1</sup> Bulkley. The Telephone as used for the Localization and Removal of Metallic Foreign Bodies in the Tissues. *Surgery, Gynecology and Obstetrics*, 1917, 24:14, 366

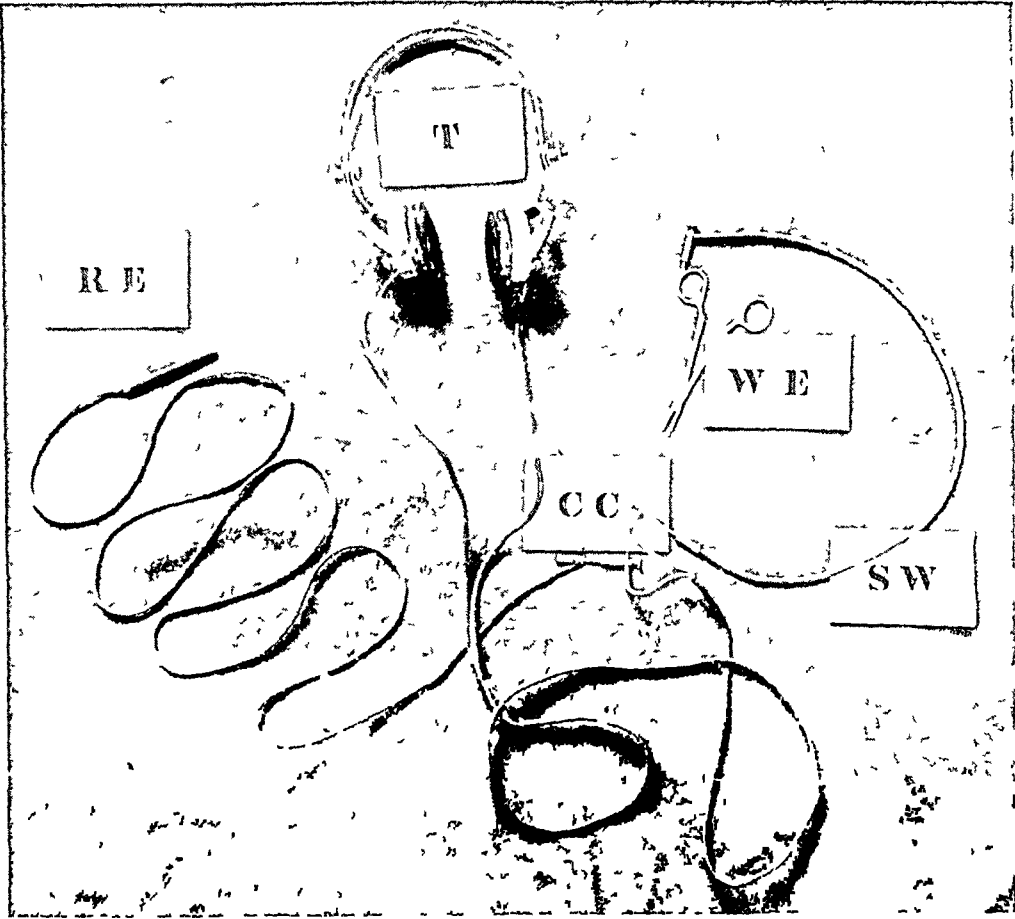


FIG 1

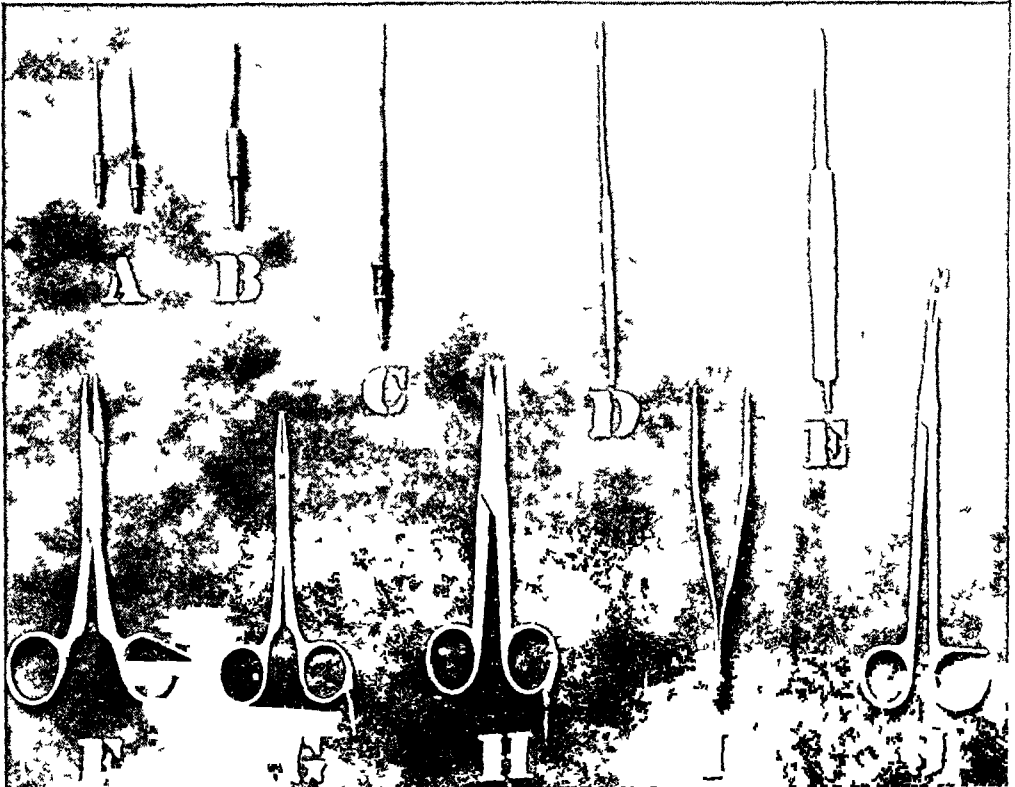


FIG 2



FIG 3

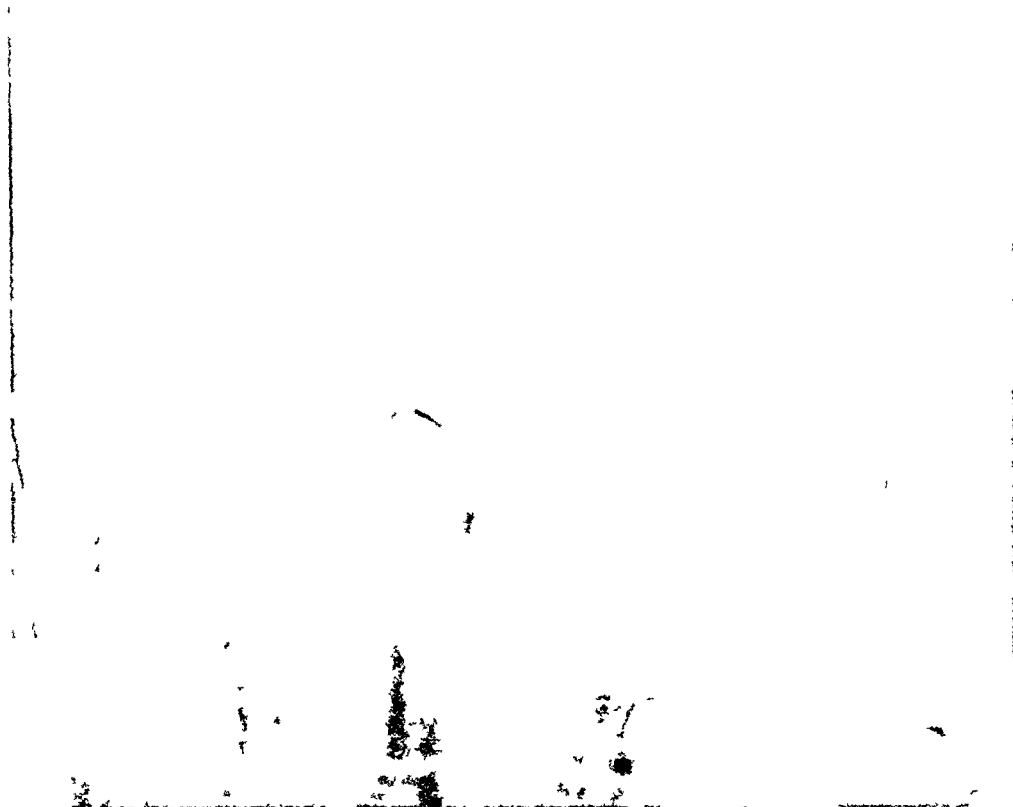


FIG 4

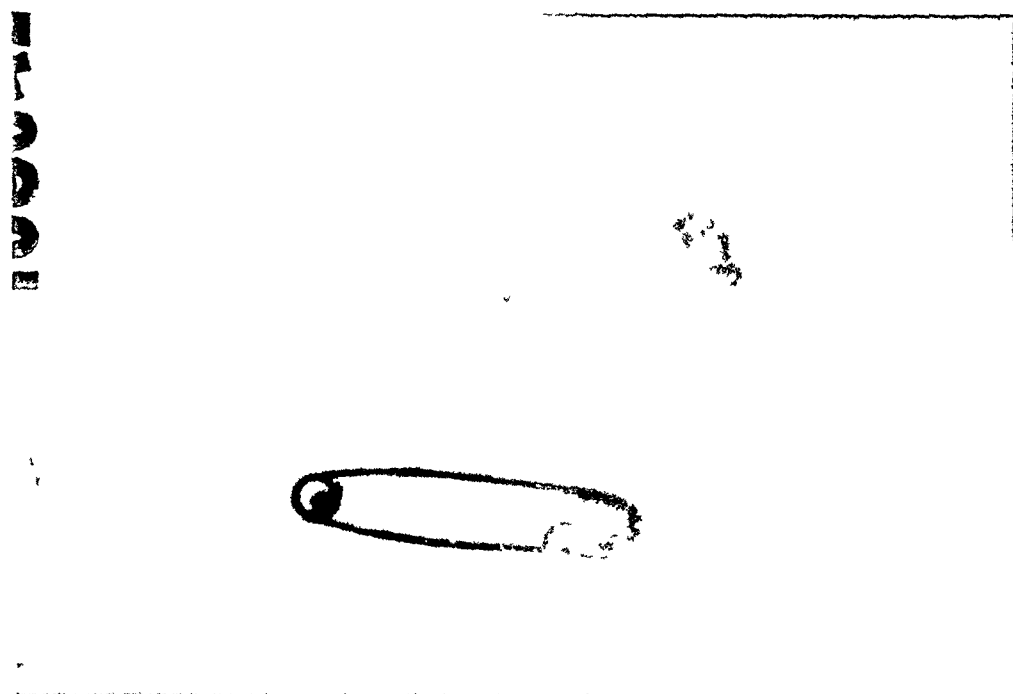


FIG 5





## REMOVAL OF NEEDLES IN THE HAND

was obtained. The fragment lay 2 inches distal to its previous position, now being over the head of the proximal phalanx. On confirming this position with the fluoroscope, the fragment was readily located with the microphone and removed, and was found lying entirely free in the tendon-sheath with a range of motion of over four inches. The second case was that of a palmar needle close to the base of the ring metacarpal. The microphone was rendered useless in this case by the close proximity (in the next room) of a powerful dynamo, and I was unable to find the needle by the ordinary dissection method. I consider neither of these failures chargeable to the microphone. In the first case it was an error on my part not to obtain more careful X-ray localization, and the error in the second case was due to lack of electrical experience.

In none of the remaining 23 cases have I had much difficulty in localizing the needle. The usual operating time is about ten minutes, and until very recently I had never taken more than 20 minutes to obtain contact. In one case I was able to remove a lumbar puncture needle broken within the vertebral arch without resorting to a laminectomy, and in another case to find in granulation tissue without anæsthesia a needle which had been already searched for for four hours without success. I feel very strongly that a method capable of reducing primary operative failure in the removal of needles from 53 per cent to 3 per cent is worthy of more extended trial.

# DEEP PALMAR HAND INFECTIONS

AN EXPERIMENTAL AND CLINICAL STUDY OF THE SURGICAL ANATOMY OF THESE CONDITIONS

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## I INTRODUCTION

Acknowledgment is due Dr Henry J Prentiss, Head of the Department of Anatomy in the State University of Iowa, for the generous use of material and facilities for the experimental part of this work, and especially to Dr Dean Osborn, formerly assistant professor in this department, for the many valuable suggestions he offered in the study of the cross-sections and the preparation of the drawings. This experimental work was based upon that of Kanavel and the methods used were similar. The results substantiate those of Kanavel in most of the important details.

*Methods of Study*—The hands used in this work were from cadavers which had been prepared for the dissecting room. The spaces to be studied were injected with a suspension of starch in water of the consistency of thin pea soup to which was added enough red lead to thoroughly color the mixture, and a few cubic centimetres of formalin to aid in the hardening of the mass after injection.

After injecting the spaces the hands were allowed to remain for twenty-four hours so that the mass would be completely solidified, and were then dissected and studied.

Three series of serial sections of hands which had been injected were made, two of which are shown in part in the accompanying drawings. These sections were made by injecting the desired spaces according to the technic described above, and then the hands were frozen solid in a block of ice in the artificial ice plant of the University Hospital for twenty-four to forty-eight hours. Then they were removed from the ice and the frozen hands cut into transverse sections by a band saw in the university shops.

## II ULNAR BURSA

The relationship between the ulnar and radial bursæ is a very close one. Dr H J Prentiss states that in the dissecting rooms where the thecæ are demonstrated by the students by distending them with compressed air, communication between the two bursæ is apparently present in about one-third of all the bodies. In the injection experiments which formed the basis for this study, the injection mass filled both bursæ when injected into either one, in every instance except one. These observations are not conclusive, of course, because the

## DEEP PALMAR HAND INFECTIONS

force used in the distention of the thecæ with air or fluid mass may have ruptured the thin buisal walls and formed an artificial communication. On the other hand, the cases observed in the clinic of the University Hospital during the past two years and in the course of an internship at the Cook County Hospital in Chicago, probably ten in number, all showed infection involving both bursæ where one, from the history, had been primarily involved. It may be, however, that the accumulation of cloudy fluid present in one of the bursæ when the infection indubitably was primary in the opposite represents not an extension of the infection to that bursa, but rather the exudate which is characteristically poured out from a serous surface incident

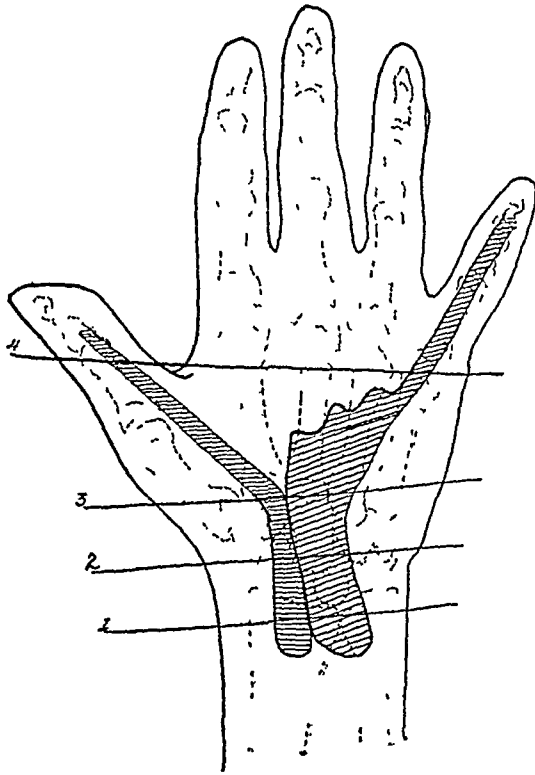


FIG 1.—Radial and ulnar bursæ. Showing levels at which cross-sections were made. Injection was made into the ulnar bursa and the mass also passed into the radial.

to any infection of the tissues in its immediate neighborhood. Practically, it would be very difficult to differentiate between such an exudate and a frankly infected exudate without opening the bursa.

*Relations of Bursa to Flexor Tendons* (Figs 1-5).—In this case the injection was made into the theca of the little finger, and the mass filled not only the ulnar bursa but also the radial.

The ulnar bursa is a serous-lined sac which extends from a point one and one-half to two fingers' breadth above the wrist-joint (proximal wrist crease) to about the middle of the palm and continues along the flexor tendons of the little finger as their common theca. At the origins of the lumbrical muscles from the flexor tendons of the second, third and fourth digits, the bursa loses its relationship to these tendons in the normal condition. Rarely, however, there will be direct com-

munication between the theca of one of these digits and the ulnar bursa. More commonly than this there will be a break in the continuity of this bursa in its extension along the tendons of the little finger.

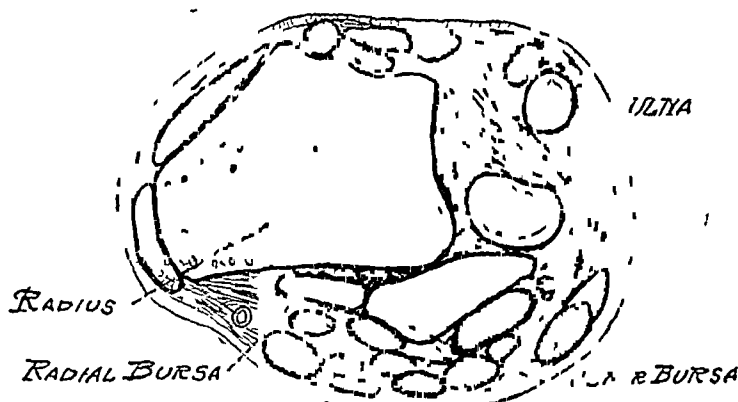


FIG 2 —Radial and ulnar bursæ. Section No 1. Note that the bursæ are entirely behind the group of tendons at this level, and are in intimate relation to the ulna and radius and the wrist-joint.

From the standpoint of infection of this bursa, one of the most important points to be brought out is its deep location throughout in relation to the tendons. In its proximal portion, it lies distinctly

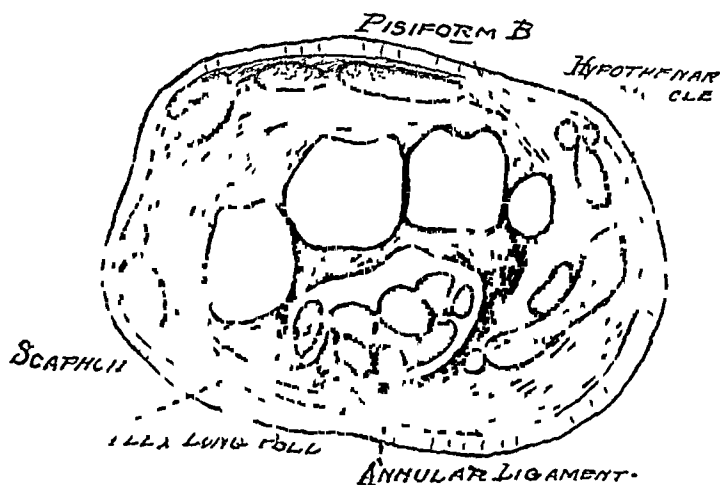


FIG 3 —Radial and ulnar bursæ. Section No 2. The bursæ at the level of the carpal joint extend somewhat anteriorly to lie under the annular ligament. Mostly, however, they are behind the tendons and are closely related to the carpal bones and the carpal joints.

behind the entire group of tendons and their muscle bellies (see Fig 2), so that by careful dissection these tendons may be lifted completely away from the bursa, leaving it *in situ*. The relationship becomes more intimate as the tendons approach the hand, although at the level of the wrist-joint the bursa still lies entirely posteriorly. Between the wrist-joint and the distal level of the annular ligament, the tendons begin to be enveloped by the bursa, especially on the ulnar side, and the individual tendons of the profundus group project to a greater

## DEEP PALMAR HAND INFECTIONS

extent into the bursa, but are not completely invested by it. That the investment is not complete is due to the fact that the individual tendons are still connected by a definite fibrous tissue pedicle, the mesotendon, to the remaining tendons of the group, and the synovial lining of the bursa is reflected back along this pedicle to the neighboring tendon and its pedicle (see Fig 3). Below the annular ligament the tendons of the little fingers become more and more completely invested (Fig 4) until at the level at which the bursa continues along these tendons as their theca (Fig 5) the investment is complete, and the tendons lie free as in a sac.

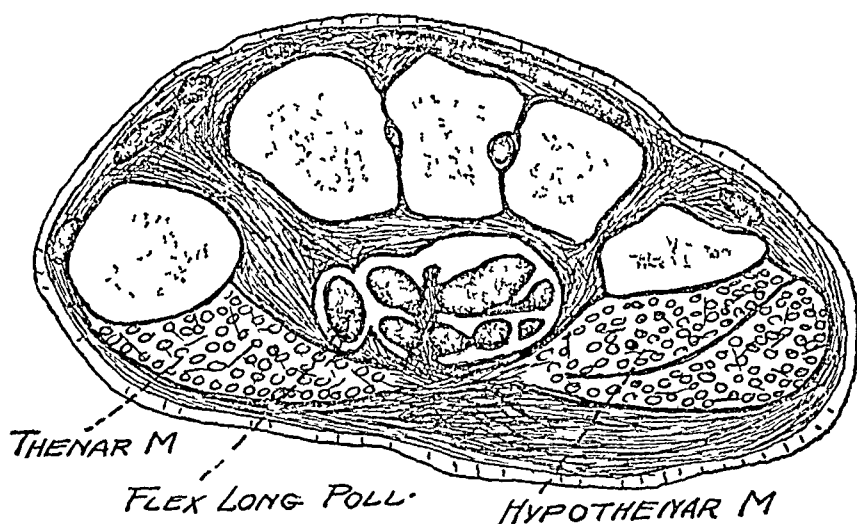


FIG 4—Radial and ulnar bursæ. Section No. 3. The radial bursa is seen separating from the ulnar and completely surrounds the tendon of the M. flexor pollicis longus. Note the intricate arrangement of the ulnar bursa in relation to the various tendons.

The complexity of the bursa is shown especially in Fig 4, and illustrates how infection of this bursa cannot be taken care of by superficial inadequate drainage. There are many minor variations in the relations of the bursa to the tendon—so that no two dissections studied are entirely alike.<sup>1</sup> The specimen which is represented in cross-section approximates the usual condition.

*Relations of the Bursa to the Forearm and Wrist-joint*—Above the level of the wrist-joint the ulnar bursa lies deeply under the tendons and directly upon the pronator quadratus muscle. At a higher level than the bursa the tendons and their muscles are separated from the radius and ulna and the pronator quadratus by a loose areolar connective tissue which presents but a poor barrier to the extension of pus when the infection has extended beyond the confines of the bursal sac. Toward the wrist the bursa lies directly upon the radius and

<sup>1</sup>Dr H. J. Prentiss observed a case in the dissecting room in which the ulnar side was in relation only to the tendons of the fourth and fifth fingers and continued along those of the fifth as in the normal condition. That portion lying on the radial side communicated with the radial bursa by a small foramen. There was no communication whatever between the two portions of the ulnar bursa.

ulna, and at the level of the wrist-joint is separated from the latter only by the ligaments of the joint (Fig 2), while above lie the flexor tendons covered by the tough vaginal fascia which envelops the forearm, and acts as a barrier to the extension of pus laterally

*Relations to Carpus and Annular Ligament*—At the level of the proximal pillars of the carpal arch the bursa is seen to lie in a space which is uncompromising in its rigidity Laterally and posteriorly the confines of this space are the carpal bones and their ligaments, while anteriorly the roof of the space is formed by the tough resistant annular ligament The relationship to these structures is so close that it is difficult to dissect the bursa free from them without destroying its integrity Furthermore, it should be remembered that the bursa

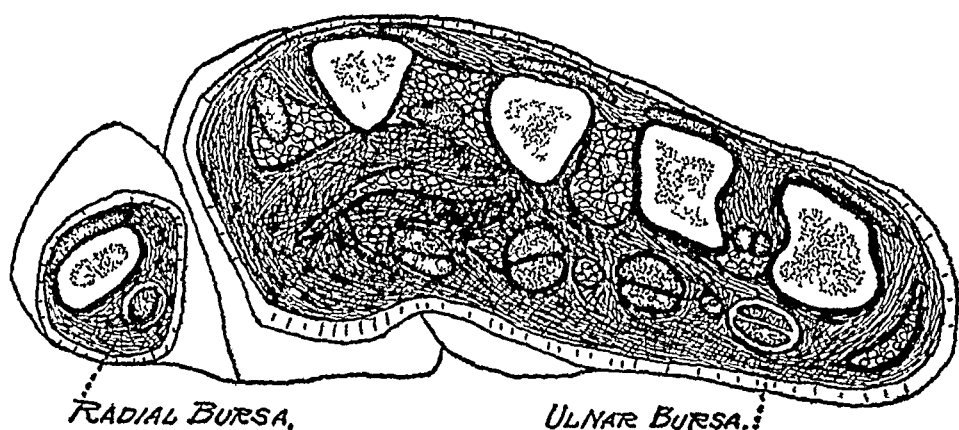


FIG 5—Radial and ulnar bursæ Section No 4 Note the extension of the bursæ along the tendons of the thumb and the little finger All relations between the bursæ and the tendons of the second, third and fourth fingers are lost at this level

still lies in much its greatest extent behind the tendons At the level of the distal row of carpal bones the space becomes decidedly narrower and the bursa even when distended by injection mass or by pus is very much smaller in cross-section than either above or below this level Furthermore, the bursa assumes a still more intimate relationship with the bones of this distal pillar and the joints between them On the other hand, the bursa has begun to extend anterior to the whole group of tendons and a small portion of it lies directly under the tough annular ligament on the ulnar side

*Relation to Metacarpal Bones*—Just distal to the level of the annular ligament, the bursa lies directly upon the three medial metacarpal bones and to a small extent over the second metacarpal At levels below this, however, intervening between the bursa and these bones are, first, the mid-palmar space, and second, the interossei muscles, and, to a certain extent, the palmar thenar space, where it lies upon the M adductor pollicis The importance of these relations is that infection extending dorsalward from the ulnar bursa in the palm of the hand would involve first the mid-palmar space or, on the radial

side, the palmar thenar space. Beyond this there would be quite a barrier to further spread dorsally by the metacarpal bones with their interossei muscles and their fascial coverings.

*Relations to Palmar Fascia and Skin*—As has been shown the bursa is covered in the forearm and wrist by either the flexor tendons, the annular ligament, or both. Distal to the annular ligament the bursa lies in part—although still a lesser part—distinctly anterior to the general body of tendons, although some of the sublimis group still lie above the bursa. It is covered, however, by a very tough, thick, resistant fibrous tissue, the palmar fascia, and an equally tough layer of skin which affords a definite barrier to the extension of pus in this direction.

*Relation to the Mid-palmar Space*—The ulnar bursa in its location in the hand lies directly upon the mid-palmar space and the relationship between the two is very intimate. The latter, however, besides being more deeply situated, extends distally to a lower level than does the ulnar bursa in the palm (see Fig. 15).

*Relation to the Palmar Thenar Space*—The ulnar bursa lies for the most part on the ulnar side of the palmar thenar space and to a small extent over it, and the relationship is a close one, so that the extension of pus from the latter to the former would be readily possible.

It should also be noted that the palmar thenar extends to a lower level in the palm than does the ulnar bursa. There is no direct relationship between the ulnar bursa and the dorsal thenar space as the M. adductor pollicis lies between them.

*Extension of Infection Beyond the Ulnar Bursa*—Because of the relationships which exist between the ulnar bursa and the structures contiguous to it, extension of infection or rupture of pus beyond the confines of the bursa occurs in certain definite and understandable locations.

Foremost amongst these is into the radial bursa. The specimen from which the serial sections were made illustrates this point. As has been stated, in a fairly large percentage of cases a normal communication exists between the two bursæ, and infection of one means of course infection of the other. Aside from these, however, the infection from the ulnar bursa extends into the radial in the majority of cases in which the ulnar is primarily involved. Whether this extension is through the unbroken synovial sac, or whether the synovial wall is ruptured, is impossible to state and is really immaterial from a clinical standpoint. The important consideration is that the infection may extend rapidly throughout the entire length of the radial bursa and increases the complexity of the condition as regards treatment, complications and ultimate deformity.



The mid-palmar space is not infrequently involved in neglected cases of ulnar bursa infection (Fig 15). It alone may be involved or the pus may also have invaded the palmar thenar space causing an extensive abscess lying deep in the palm. The rupture from the bursa into the space usually takes place on the posterior surface of the former at the point where the bursa is interrupted along the tendons to the third and fourth fingers by the origins of the lumbrical muscles. If the rupture occurs from the bursal projection along the tendon to the index finger, and this is much less frequent, the pus will then invade the palmar thenar space rather than the mid-palmar, and the latter may or may not become later involved.

Extension of the infection in the ulnar bursa beyond its proximal confines is common (Fig 15), and in this case there may be produced a rapidly extending cellulitis with the formation of pus which dissects the flexor muscles away from the radius and ulna and interosseous ligament—as high as the elbow. This pus tends to remain deep—for above it lie the muscles and tendons, and laterally and medially, as has been indicated, the tough vaginal fascia of the forearm tends to prevent it from pointing in these directions. In some cases in which the infection is of low-grade virulence the collection of pus breaking through the bursa does not spread rapidly and remains as an abscess in the lower part of the forearm with the tendons and the muscles floating upon it. In other cases the pus dissects its way between the bellies of the muscles and points at one or several places on the anterior or lateral surface of the forearm.

Not infrequently pus will point just proximal to the annular ligament on the anterior surface of the wrist, due to the fact that under this ligament the bursa lies partly anterior to the tendon group especially on the ulnar side, and the pus, being unable to penetrate the tough resistant ligament, works its way proximally and appears under the skin of the wrist. And occasionally, in neglected cases, the infection will point under the skin in the palm by burrowing through the dense palmar fascia.

Involvement of the carpal joints and bones, one of the very serious and frequent complications, is readily explained by the intimacy of the relationship between these structures and the ulnar bursa. The pus collecting in the bursa in the wrist is deeply placed, and firmly held by the unyielding structures surrounding it, so that extension to the carpus is inevitable in neglected cases. The same holds true regarding the wrist joint but not so strongly, for at this level the pus tends to work proximally, and breaking through the bursal confines, relieves the tension by extension up the forearm. Infection extending to one of the interphalangeal joints or the distal phalanx of the fifth finger should also be mentioned. This is not common.

## DEEP PALMAR HAND INFECTIONS

### III RADIAL BURSA

This bursa is the theca of the flexor pollicis longus tendon and extends from a point about one and one-half to two fingers' breadth above the level of the wrist-joint, to the insertion of the tendon in the last phalanx of the thumb. Its relations to its tendon are about those which exist between the ulnar bursa and the tendons with which it is related. In the forearm it is deeply situated and lies behind the tendon.

In the wrist the bursa begins to partially envelop the tendon, and at the point where the tendon hooks around the trapezium to pass toward the thumb, the envelopment is complete.

*Relation to Ulnar Bursa*—This has already been discussed. It may be noted that when a communication between the two bursæ is found, it is usually under the annular ligament or in the region of the wrist-joint, and varies in size from a very small foramen to almost complete absence of dividing wall.

*Relation to Mid-palmar Space*—The radial bursa is not intimately related to this space.

*Relation to Palmar Thenar Space*—This space, the boundaries of which will be detailed later, lies close to the radial bursa, especially at the level where the flexor longus pollicis diverges from the flexor tendons of the four fingers in the palm. The palmar thenar space and the radial bursa lie approximately in the same plane, but in some cases the latter has been found to partially overlie the former.

*Relations to Carpal and Wrist-Joints and Annular Ligament*—The relations of the radial bursa to the carpal and wrist-joints are similar to those of the ulnar bursa. Where the tendon of the flexor pollicis longus lies under the annular ligament, it is nearly completely invested by its bursa. Consequently pus collecting in the bursa is present above as well as behind the tendon, and that lying above sometimes spreads toward the forearm to a point in the wrist just proximal to the edge of the annular ligament.

*Relations to Thenar Muscles and their Nerve Supply*—After passing around the trapezium, the flexor pollicis longus tendon now completely invested by the radial bursa lies to a certain extent under the thenar group of muscles. And in this connection it should be emphasized that the branch from the median nerve which supplies two and one-half of these muscles passes across the bursa to reach them, at a point between the annular ligament and a finger's breadth distal to it. This is of particular importance in relation to incisions made to drain this bursa, and has been brought out by Kanavel and later by P. Lecene.<sup>2</sup>

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<sup>2</sup>Remarques sur le traitement des Phlegmons graves des gaines synoviales de la Main. Journal de Chirurgie, vol. vi, 1911.

*Extension of Infection Beyond the Bursa*—Involvement of the ulnar bursa from an infection primary in the radial, has already been considered. Also infection may involve the wrist and carpal joints and extend up into the forearm, just as from ulnar bursa infection.

Extension to the palmar thenar space may occur, but clinically this takes place only after infection in the radial bursa has first extended to the ulnar. In this case the involvement of the palmar thenar space is probably by way of the ulnar bursa rather than the radial. Furthermore when the infection extends from the bursæ to involve the deeper spaces, it is much more common to have the mid-palmar space involved than the palmar thenar, and the infection may or may not then involve the latter.

Infection of the interphalangeal joint of the thumb sometimes occurs and occasionally osteomyelitis of the distal phalanx.

#### IV MID-PALMAR SPACE<sup>3</sup>

The relations of this space are shown in Figs 6-10.

It is shield-like in shape (Figs 6, 9 and 10) and lies deeply in the ulnar half of the palm, *behind the flexor tendons* and the *ulnar bursa*, the latter overlying the mid-palmar space in its proximal portion. Distal to the ulnar bursa, the tendons of the third and fourth digits and their lumbrical muscles, as well as the lumbrical muscle of the fifth finger, overlie the space. Behind the space lie the third and fourth metacarpal bones and their interosseal muscles and on the radial side the palmar thenar space which lies upon the M. adductor pollicis.

Proximally the space extends to about the level of the annular liga-

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<sup>3</sup>In many of the hands which have been studied in the dissecting room, the middle palmar space and the palmar thenar space were lined by a definite, circumscribed glistening thin membrane in every way resembling that lining the ulnar and radial bursæ. In one of these cases histological sections of this tissue taken from the mid-palmar space showed the characteristic picture of synovium. In other specimens, tissue suggesting synovium was obtained, but it was not so definite, while in others the tissue was only compact connective tissue without the structure of synovium. These sections were all made from tissue taken from cadavers which had been preserved for a long time and the hands had become quite dried, so that clean-cut histological preparation was not possible, nevertheless we have been able to show conclusively that in one case at least, we had to do with definite bursæ rather than connective-tissue spaces.

It is readily conceivable why bursæ might be present in these positions in the hand. The ulnar bursa is interrupted in the palm in its relations to the tendons of the middle and ring fingers, by the origins of the lumbrical muscles from these tendons. The mid-palmar space takes the place of the ulnar bursa in this location. Similarly, the ulnar bursa loses its relation to the tendons of the index finger in the palm, and the palmar thenar space or bursa allows free play of these tendons upon the adductor pollicis muscle beneath it.

The dorsal thenar space is a connective-tissue space and there is no anatomical reason why it should be a bursa.

## DEEP PALMAR HAND INFECTIONS

ment in the palm. Rarely it may extend even higher than this, but never into the wrist, because of the intimate relationship of the ulnar bursa to the carpus. Fig 6 represents the highest extent of this space that has been observed in this work. Medially the space extends to

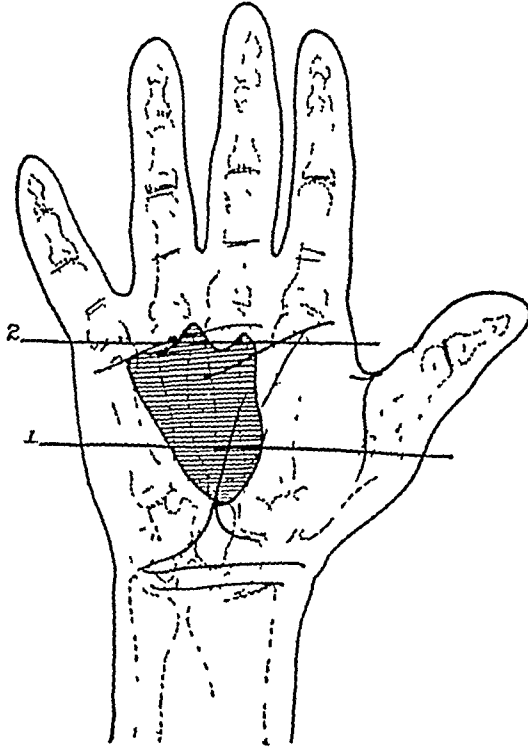


FIG 6—Middle palmar space. Injection was made directly into the space, and represents the usual shape and location. Note the projections along the lumbrical muscles of the ulnar three fingers. The levels of the cross-sections are indicated.

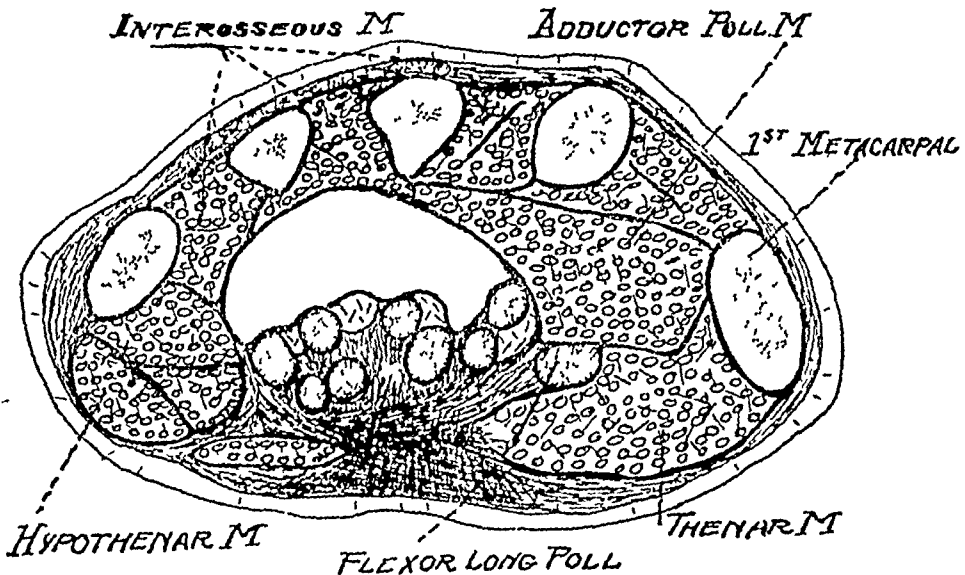


FIG 7—Middle palmar space. Section No 1. Note the size of the space at this level. It does not extend radialward to the flexor of the index finger. It lies behind the tendons on the interossei muscles.

the tendons of the fifth finger with their bursal investment. On the radial side the space is limited by thin connective barrier which passes from the flexor profundus tendon of the index finger to the line of origin of the m adductor pollicis from the middle metacarpal bone—

this connective-tissue wall separating the mid-palmar space from the palmar thenar space

There is close relationship between the mid-palmar space and the lumbrical muscles of the third, fourth and fifth fingers. At the point where these muscles leave the tendons from which they take origin, the space is continued along on the under side of these muscles as definite

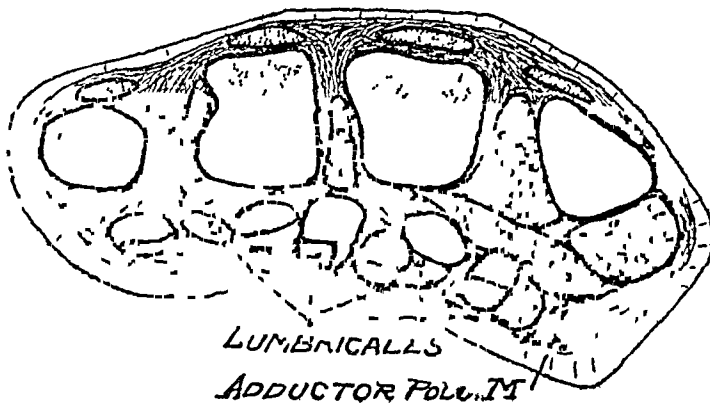


FIG 8 —Middle palmar space Section No. 2 At this level the characteristic prolongation along the lumbricals is shown. In this case it has not extended along that of the little finger to this level.

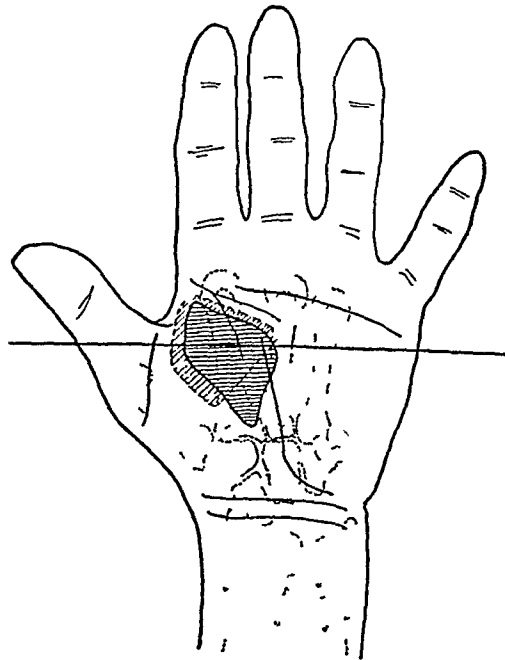


FIG 11 —Thenar spaces. Injection made directly into the palmar thenar space passed through the M. adductor pollicis to fill the dorsal thenar space. The projection of the former along the lumbrical muscle of the index finger is shown. Level at which a cross-section is shown as indicated.

prolongations (Figs 8 and 17). These are variable in extent, however, and may be lacking especially along the lumbrical to the fifth finger. This relationship does not exist between this space and the lumbrical muscle of the index finger. Toward the distal portion of the space at a level below the ulnar bursa, the space is more super-



FIG 9 —Middle palmar space. Dissection showing the flexor tendons of the third, fourth and fifth fingers exposed. The annular ligament has been cut and reflected. The tendons to the index finger and thumb are shown drawn to the side.



FIG 10 —Middle palmar space Dissection made to show the injection mass lying in the space The flexor tendons to the third fourth and fifth fingers are shown reflected toward the fingers, while those of the index finger and thumb are drawn to the side Note that toward the wrist the mass does not extend as far as the annular ligament



FIG 13 —Thenar spaces Dissection to show the palmar thenar space The tendons and lumbrical of the index finger are pulled aside The floor of the space is the M adductor pollicis The outline of this space is shown by a dotted line





FIG. 14.—Thenar spaces. Same dissection to show the dorsal and palmar thenar spaces. The thumb is drawn toward you and you are looking directly between it and the index finger. The adductor muscle is seen with the dorsal space on one side and the palmar on the other—these have been outlined by a dotted line.

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ficial, and except where the tendons overlie, is covered only by the tough skin and dense fascia of the palm

The distal boundary of the space—except for the lumbrical prolongations—is about at the level of the distal transverse crease of the palm. Here the space lies in close relationship to the proximal por-

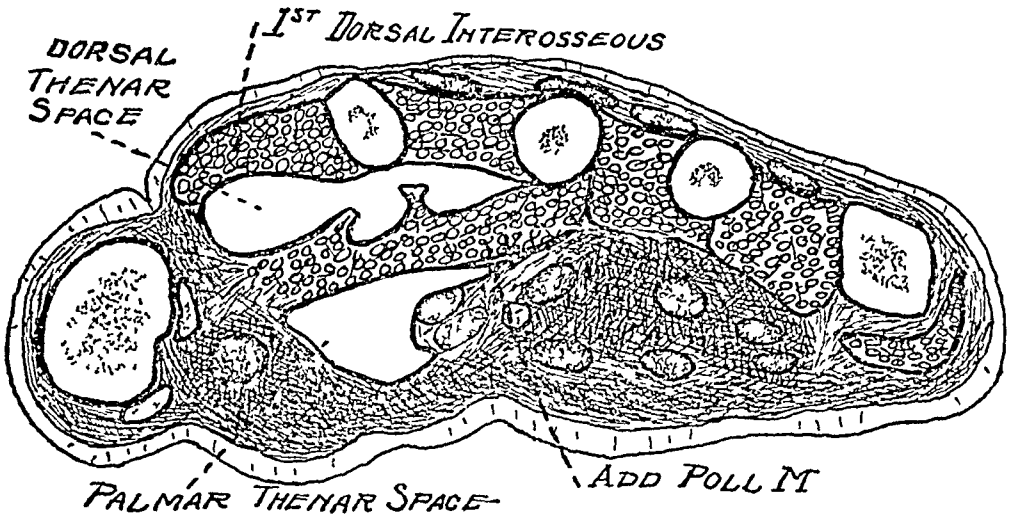


FIG 12 —Thenar spaces. This cross-section gives a good idea of the relationship between the two thenar spaces and the M adductor pollicis which separates them. Note the intimacy between the palmar space and the lumbrical muscle of the index finger.

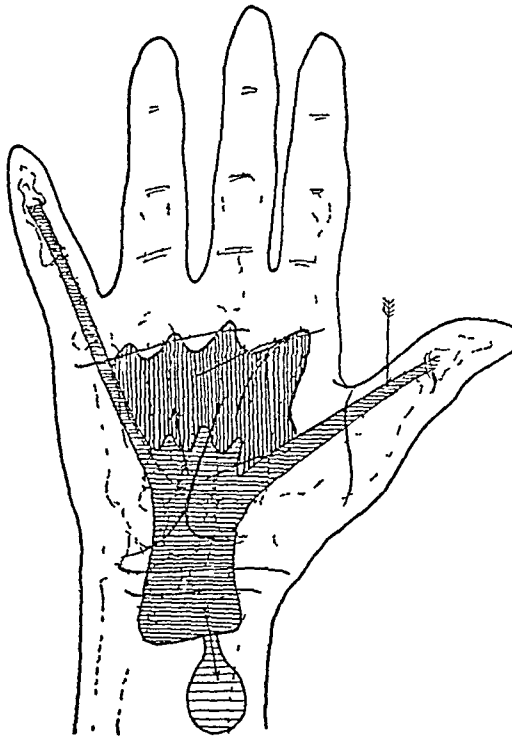


FIG 15 —In this case the injection was made into the theca of the M pollicis longus. The mass filled both the ulnar and radial bursæ and broke through the former, filling both the middle palmar and palmar thenar spaces. It also broke through the bursa at the wrist and infiltrated the cellular tissue between the muscle and the radius.

tions of the thecæ of the flexor tendons of the third and fourth fingers

*Extension of Infection beyond the Mid-palmar Space* —Because of the very intimate relationship between the mid-palmar space and the palmar thenar spaces, extension of infection from one to the other is of common occurrence where either has been primarily involved (Fig

16) This is so frequently found clinically that any infection which has existed in the mid-palmar space for over forty-eight hours will in the majority of cases have extended to the palmar thenar. When both spaces are involved, there is produced an extensive abscess lying behind the flexor tendons and the pus is held under considerable tension.

In some cases in which the diagnosis of involvement of both spaces is made, one having been clearly primarily infected, at the time of operation it will be found that in the secondary space only a cloudy serum or a thin pus is obtained. In the primary space a different pus is present—thick and creamy. In these cases, either there is found in the space secondarily involved the so-called “protective pus” or

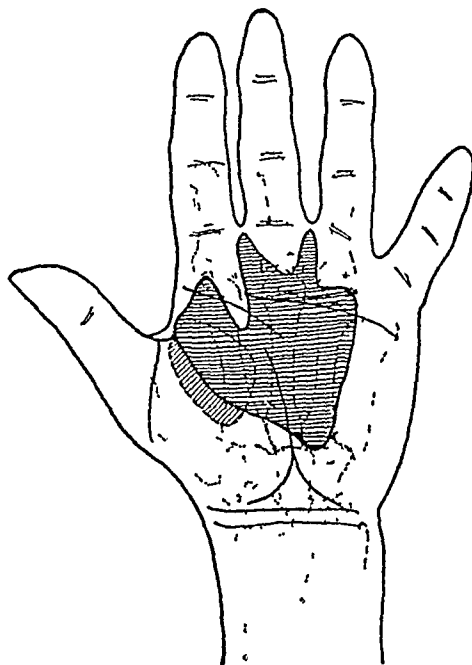


FIG. 16.—Injection made into the middle palmar space and rupturing into the palmar thenar space. From the latter it passed over the free margin of the adductor pollicis muscle in the web between the thumb and index finger to enter the dorsal thenar space. The latter is dotted. Note the marked prolongation along the lumbrical muscle of the middle finger, the injection mass extending to the web. Also, the middle palmar space reaches a point slightly above the distal limit of the annular ligament.

the infection has passed through the wall between the two spaces without destroying it. When the connective tissue wall is broken down, and this is what usually takes place, the rupture occurs in its proximal portion—judging from the injection mass experiments.

Infection not infrequently extends along one of the lumbrical prolongations of the mid-palmar space to involve the cellular tissue in the web between two of the fingers. The pus may point in the web, or in the palm proximal to it, and in some cases extends onto the dorsum of the hand.

In some cases, especially those of long standing, or those in which infection has occurred by a penetration wound into the space, the pus may present in the middle of the palm, burrowing its way at a level

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distal to the ulnar bursa, between the tendons and through the dense palmar fascia and tough skin

Involvement of the ulnar bursa also may occur, because of the intimate relationship between the space and this bursa. This is not so common, however, clinically or experimentally, as extension from this space into the palmar thenar space. Extension from the mid-palmar space into the wrist cannot occur without first rupturing into the ulnar bursa, because the space extends only to the level of the carpus. Above this level, the ulnar bursa is closely attached to the carpal arch.

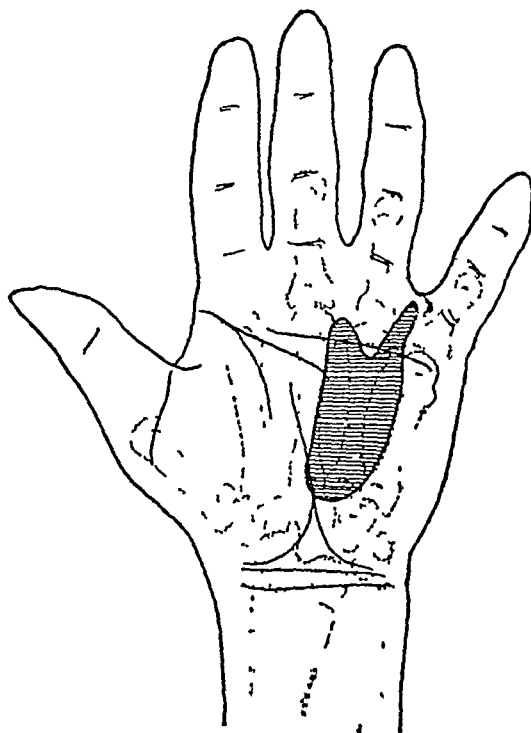


FIG 17 —Injection made directly into the middle palmar space. In this case the mass passed up the lumbrical prolongation of the little finger and appeared at the web between this finger and the ring finger. Pus will sometimes take this course.

Rarely, the infection may burrow dorsally through the interosseal muscles between the third and fourth or fourth and fifth metacarpal bones to appear on the dorsum of the hand, and in old neglected cases the involvement of the metacarpal bones must be mentioned.

*Extension of Infection into the Space from other Structures*—As has been noted, the thecae of the tendons of the third and fourth fingers are interrupted in the palm. When either of these becomes infected and the infection extends beyond the confines of the thecal sac, involvement of the mid-palmar space often takes place along the lumbrical prolongation related to the theca involved (Fig 18). This relationship does not exist with the theca of the fifth finger, for it is continuous with the ulnar bursa—nor does it exist with the theca of the second finger which lies beyond the confines of the mid-palmar space.

Extension of a collar-button infection, *ie*, one involving the cellular tissue in the web between two fingers, may infect the mid-palmar space by extending along the lumbrical prolongation related to the web primarily infected

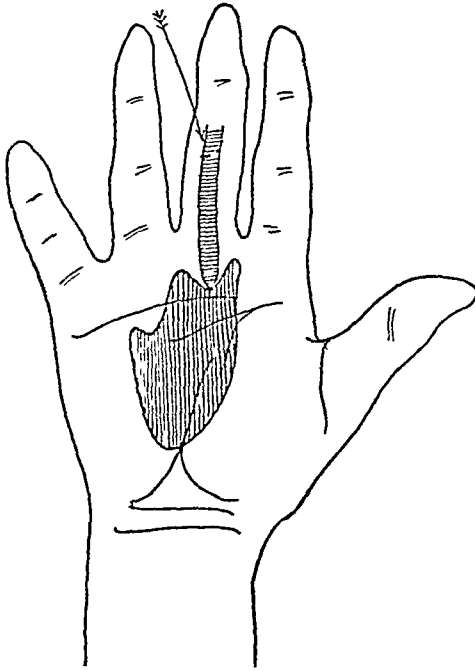


FIG 18 —Injection made into the theca of the middle finger under considerable force passed beyond the theca and entered the middle palmar space

#### V PALMAR THENAR SPACE

This is a connective-tissue space<sup>3</sup> analogous to the mid-palmar space. It is a smaller space than the latter, and lies on the radial side of the middle metacarpal bone directly upon the *M. adductor pollicis* (Fig 12). Medially its boundary is the thin connective-tissue membrane which extends from the tendon of the index finger to the origin of the adductor pollicis muscle, this membrane dividing the palmar thenar from the mid-palmar space.

Proximally the space extends not quite to the level of the annular ligament. On the radial side the space lies close to the flexor tendon to the thumb until that point is reached where the *M. adductor pollicis* passes under the flexor tendon. Here the boundary passes up toward the head of the second metacarpal bone until the lumbrical muscle of the index finger is reached. A prolongation of the space is continued along this lumbrical muscle for a short extent (Figs 11 and 13). The distal level of the palmar thenar space is approximately the distal transverse crease of the palm.

The palmar thenar space is a deep one lying directly upon the fascia of the *M. adductor pollicis* which forms its posterior boundary. Anteriorly lie the flexor tendons and the lumbrical muscle to the

index finger—and to a small extent, that portion of the ulnar bursa which is related to these tendons. Between these tendons and the radial border of the space, the latter is covered only by the dense palmar fascia and skin.

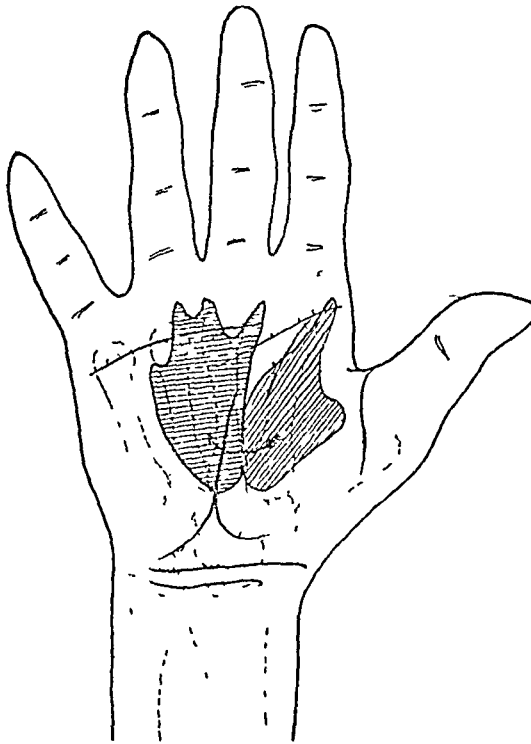


FIG 19 —Injection made into the palmar thenar space passed from it into the middle palmar space, breaking through the fascial boundary which separates them, well toward the upper limits. The lumbrical prolongations are distinctly shown.

*Extension of Infection Beyond The Palmar Thenar Space*—The most frequent point of extension beyond this space is into the mid-palmar space. This is commonly seen clinically (Fig 19).

The next most frequent point of extension is into the dorsal thenar space which is separated from the palmar thenar only by the M adductor pollicis. Extension may take place in one of two ways. The most common line of extension is to have the pus in the palmar thenar space burrow its way through the adductor muscle, finding a ready line of cleavage between the oblique and the transverse bellies, and thus pass directly into the dorsal thenar space (Figs 11 and 20), or the pus may point toward the web between the thumb and index finger, and passing over the web margin of the M adductor pollicis extend into the dorsal thenar space (Fig 16). In some cases the pus will point in the palm directly over the space just to the radial side of the tendons of the index finger, without extending to the cellular tissue of the web, and without passing through the M adductor pollicis to attack the dorsal thenar space.

Extension of infection may occur along the lumbrical muscle of the index finger, and present on the outer side of the finger or even involve the subcutaneous tissue on the dorsum of the first phalanx.

Involvement of the ulnar bursa or radial bursa is possible, but clinically this is very infrequent except in those cases in which the infection has first extended to the mid-palmar space

When infection of the theca of the index finger occurs and extends

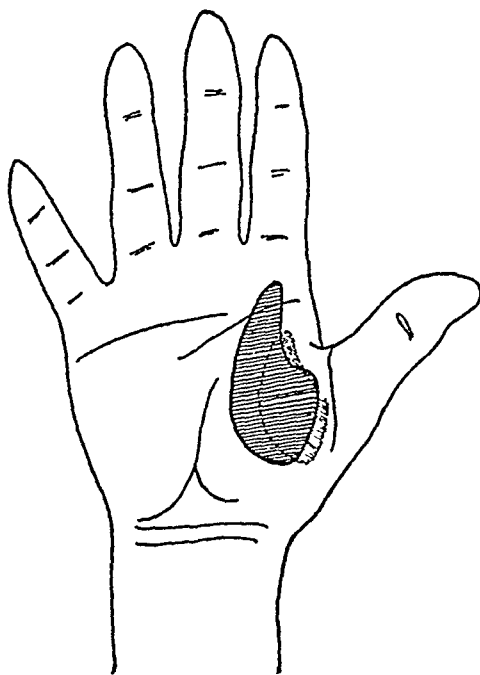


FIG 20 —Injection made directly into the palmar thenar space. It passed through the adductor muscle and partially filled the dorsal thenar space which is shown by a dotted line. Here also is shown the characteristic extension of the palmar thenar space along the lumbrical muscle of the index finger.

beyond the confines of the theca, the palmar thenar space is very frequently involved, the extension taking place along the lumbrical prolongation which is intimately related to this theca (Fig 21)

#### VI DORSAL THENAR SPACE

This is definitely a connective-tissue space. It extends from the web between the thumb and index finger, ulnarward to the middle metacarpal bone. It is bounded in front by the M adductor pollicis, and behind by the first and second interosseous muscles and the second metacarpal bone. In the web between the thumb and index finger the space is superficial and is covered only by the subcutaneous tissue and skin (Fig 14).

Its contents consist of a fairly loose connective tissue and the branch of the radial artery which, piercing the first dorsal interosseous muscle, courses through this dorsal thenar space to pass into the palm through the M adductor pollicis. This space is separated from the palmar thenar only by the adductor muscle of the thumb.

Extension of infection beyond the confines of the dorsal thenar space occurs most frequently into the subcutaneous tissue of the web between the thumb and index finger.

## DEEP PALMAR HAND INFECTIONS

Drainage instituted to relieve pus pointing here will often cause the infection to completely subside without the diagnosis of the extent of the infection into this deeper space having been made. The infection will sometimes extend through the M. adductor pollicis or

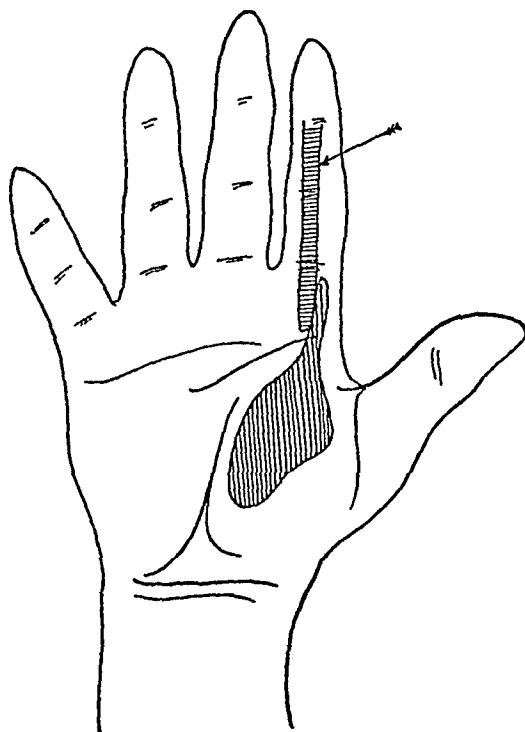


FIG. 21.—Injection in this case was made into the theca of the flexor tendons to the index finger under considerable force. It passed through the confines of the theca and entered the palmar thenar space at the lumbrical extension of the space.

over its free margin, to involve the palmar thenar space. Infrequently infection in the dorsal thenar space extends through the first dorsal interosseus muscle and appears on the dorsum of the hand.

### VII. POINTS TO BE EMPHASIZED

1. The radial and ulnar bursæ lie completely behind the flexor tendons in the wrist, and extension of infection at this level tends to produce deep cellulitis of the forearm and involvement of the wrist joint.

2. Under the annular ligament these bursæ lie partially anterior to the flexor tendons. Infections tend to point on the anterior surface of the wrist proximal to the ligament as well as into the carpal joints.

3. The nerve supply to several of the thenar muscles crosses the radial bursa in the region of the distal border of the annular ligament.

4. Intimate relationship between the bursæ and the deep spaces of the palm.

5. Mid-palmar space does not extend proximal to the distal level of the annular ligament. Infection extending toward the wrist from this space must involve the ulnar bursa.

6. Intimate relation between the mid-palmar and palmar thenar spaces—the boundary between them being a thin wall of connective tissue.



7 Relationship between the theca of the index finger and the lumbrical extension of the palmar thenar space Similar relationship between the thecæ of the middle and ring fingers and the lumbrical extensions of the mid-palmar space

8 The mid-palmar and palmar thenar spaces may be true bursæ as has been shown conclusively in one case This should be borne in mind in dealing with affections of the hand other than acute infections It is conceivable that such conditions as acute traumatic bursitis and tuberculosis of these bursæ may occur



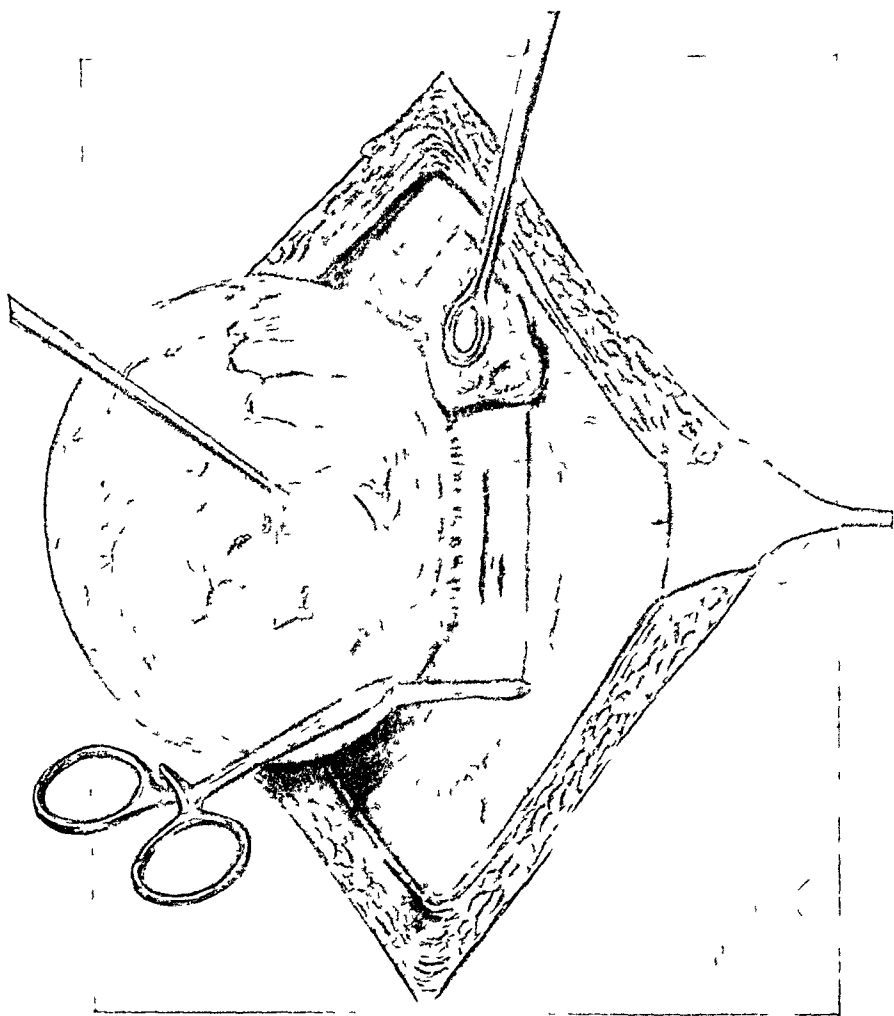


FIG 1—Ascending vena cava wounded in the removal of a retroperitoneal mixed-cell sarcoma  
Note clamp placed on lower portion of inferior vena cava Note ureter deflected over tumor mass

# LACERATION OF THE INFERIOR VENA CAVA REPAIRED BY SUTURE RECOVERY

BY HERBERT P COLE, M D

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AN investigation of surgical literature discloses very few instances of extensive laceration of the inferior vena cava with recovery. My experience with a recent grave injury of such a nature prompts me to present it to the profession.

On December 6, 1916, I operated a thirteen-year-old negro, referred by Dr Samuel Alman of Gilbertown, Alabama. The patient presented a rapidly growing tumor mass bulging in the upper right quadrant of the abdomen. At operation a globular tumor mass 12 x 19 cm was found in the retroperitoneal space.

After incising the retroperitoneal tissues, the ascending and transverse colon were easily displaced outward and upward. The ureter deflected over the most prominent portion of the tumor was dissected from the tumor mass and displaced outward without great difficulty. Quite firm capsule-like adhesions fixed the tumor to the lower thoracic vertebræ, and a quite definite thickened peduncle originated from the right side of the twelfth thoracic vertebra. The tumor mass forced the inferior vena cava and aorta quite markedly to the left of the spinal vertebræ.

While separating the dense capsule-like adhesions from the large vessels, we produced two longitudinal rents in the anterior surface of the inferior vena cava, one about  $3\frac{1}{2}$  cm and the other about 1 cm in length. A very profuse hemorrhage was controlled temporarily by a gauze pack. The first efforts to disclose the nature of the hemorrhage were unsuccessful. The pack was finally held firmly compressed by the assistant's hand, and the tumor rapidly removed as the patient was almost exsanguinated.

The vena cava was finally exposed sufficiently to allow an ordinary serrated Pean type clamp to be placed upon the vena cava below the rent, a gauze sponge on a sponge holder controlling some slight oozing from above. Both lacerations were quickly whipped over with a single stitch of fine catgut on a fine needle. Upon removing the clamp and sponge there was very little oozing. The entire cavity was rather loosely packed with iodoform gauze and the retroperitoneal edges were stitched to the anterior peritoneal wall. The patient was pulseless at the end of operation, but was carried through a quite exciting twenty-four hours with intravenous saline, and was discharged from the hospital within three weeks with the abdominal wound practically healed.

In consideration of our necessarily rough handling of the inferior vena cava we were not disappointed in anticipating vascular disturbances. Ten days after the operation the patient developed a quite extensive œdema of his entire right leg. This persisted for several days but gradually disappeared by the tenth day.

Up to the present time, now about two months since operation, the patient has had no further complications.

# INTRAPERICARDIAL TRAUMATIC HEMORRHAGE

TWO UNUSUAL EXPERIENCES IN HEART AND PERICARDIAL SURGERY

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PENETRATING wounds of the heart or pericardium which are seen in civil surgery are rarely observed upon the operating table, for the surgeon is usually indebted to the fact that he happens to be present when the case is brought in for the chance to operate. This was my good fortune in both these cases. Even in the vast operative experience furnished by the present war there are very few cases reported of operative attack upon the heart or pericardium. In fact, after a rather cursory review of the available reports I was able to find only two, one a case of suppurative pericarditis, operated on some weeks after the injury, and one fatal case of heart perforation. Therefore I feel very little hesitancy in presenting these two cases from the Cincinnati General Hospital service, for each presents certain interesting points in diagnosis and treatment, and one in especial shows a clinical condition of the most extreme rarity.

In general it may be said that very few traumatic lesions of the thorax demand operative relief. The more we keep our hands off the average gunshot wound, stab wound or other injuries the brighter are our patients' chances of dying of old age. But there is a definite type of thoracic injury in which interference must be prompt, and no considerations such as the critical condition of the patient must interfere with such operative attack. The lesion to which I refer is acute hemorrhage of large amount into the pericardial sac, accompanied by very slight opportunity for the free outlet of the hemorrhage. This will be shown in both of these cases.

CASE I—*Stab wound of pericardium, intrapericardial hemorrhage.* A negro laborer, aged twenty-seven years, was admitted to the East Surgical Service of Dr. Frank Fee, who kindly allowed me to operate. Examination showed a stab wound about an inch in length, parallel to the sternum and about an inch from its left border. This wound passed through the fourth left costal cartilage, which was completely severed. The instrument used was the large blade of a pocket knife, which was declared to have been driven in its entire length. The wound was bleeding freely at first, but later the flow was not as free, as the opening became plugged by blood-clot. The man was in dyspnoea, which increased in degree, and there were hyperresonance and very faint breath sounds over the entire left chest, leading to the diagnosis of pneumothorax. The area of cardiac dulness was greatly in-

creased, but was slightly more to the right than normal, had a flat note, and the heart sounds were barely audible. There was slight cyanosis of the lips which increased perceptibly. The physical signs were correctly interpreted to mean hemorrhage into the pericardium, but the cyanosis and dyspnoea were construed to be caused by the pneumothorax. The operation showed this to be incorrect. His pulse was 100 and not very good, but was regular. Respirations were 28 and temperature was normal.

From the location of the wound it was difficult to understand how the heart could have escaped puncture, so with the physical signs of fluid in the pericardium, the muffled heart sounds and the character of the pulse, I made the tentative diagnosis of stab-wound of the heart, and operated immediately.

Ether anaesthesia, drop method. Benzine and iodine skin preparation over chest. A rectangular osteoplastic flap was then made in the following manner. An incision was made over the middle of the sternum, extending from the second to the fifth costal cartilages. From the upper and lower ends of this incisions were made at right angles to it for a distance of five inches. This skin and muscle flap was dissected back and the cartilages of the third and fifth ribs were divided subperichondrially. The fourth was already divided by the injury. The intercostal spaces were then incised and the whole osteoplastic flap bent backwards, breaking the ribs. This was done with very little force and I judge the fractures occurred at the junction of the cartilage and rib. The internal mammary artery was ligated.

This gave splendid access to the anterior mediastinum. The triangularis sterni was incised and pushed aside, and the pleura was seen to lie very close to the left sternal margin, and the rent was seen where the knife had perforated. This rent and the underlying tear in the pericardium were as wide as the external wound, so the knife must have gone in up to its widest part. Consequently, we fully expected to find the heart perforated. The pericardium was now grasped with forceps and opened in the long axis of the heart. A tremendous gush of blood came out, apparently under tension. The condition of the patient improved remarkably, the respirations and pulse improved and the cyanosis lessened greatly. I now realized that I had been dealing with a case of heart tamponade, and that the respiratory symptoms, poor pulse and cyanosis were due to that and not to the pneumothorax.

The heart was now inspected and no stab wound was present, but the source of hemorrhage was seen to be quite a large pericardial vessel. This was ligated and the field remained dry.

The interesting feature of the case was now seen. The heart and its movements were now studied to ascertain how it had escaped puncture, and the following condition was evident. The heart in diastole lay close to the thoracic wall and overlapped the wound of entrance by fully two inches. In extreme systole, however, the extreme left border of the heart lay about one inch

to the right of the perforation. In other words, the knife must have gone in during systole and just missed the heart. In diastole it would certainly have been caught. It must be remembered, also, that at the time he was stabbed the heart lay further to the left than when we saw it, for the pneumothorax pushed it to the right.

The pericardium was sutured with continuous suture of cat-gut, previously washing out the sac with salt solution. No drainage was used. The osteoplastic flap was pushed back into place and was held by a few sutures placed in the perichondrium and fascia. Skin flap sutured with silk worm gut. He left the operating table in good condition.

The next day the breath sounds were weak over the collapsed lung, but were audible over entire chest. Heart action regular.

Three days later the breath sounds were normal. Apex beat in fifth interspace. Temperature normal. He left the hospital nineteen days after admission, with a perfect cosmetic result. Union was prompt and no deformity or irregularity of the chest was perceptible. Heart and lung action were normal.

CASE II — *Stab wound of pericardium and right ventricle, intrapericardial hemorrhage, unsuccessful attempt at heart suture*. This case, although terminating fatally, certainly deserves to be reported. After a very thorough search of the literature of cardiac surgery I have not encountered a similar condition, and I am glad to have the coroner's report of the post-mortem to substantiate my own unsupported statement.

S. W., colored, aged thirty years, was stabbed in the chest shortly before admission. He entered the South Surgical service of Dr. C. E. Caldwell, to whom I am indebted for the privilege of operating. I saw the man when he was brought to the hospital and had him transferred immediately to the operating room after a hurried examination. Patient was almost moribund on admission, and he presented a stab wound to the left of the sternum at the sixth interspace. He had lost a large amount of blood, but this hemorrhage had ceased when the wound was packed in the receiving ward. He presented a picture similar to the last case, but was in much worse condition. His pulse was very bad, heart sounds were inaudible over the precardium, there were the physical signs of fluid in the pericardium, but the area of flatness was much further to the right than normal, due to the accompanying pneumothorax, which was very pronounced. Dyspnoea was present, but not of very great severity. There was slight cyanosis of the lips.

Operation was performed about ten minutes later. The same incision of the pericardium liberated a gush of blood and, as before, the condition of the patient improved to a great extent. The heart was now inspected and no perforation was seen on the presenting surface.

The hemorrhage, however, continued, and kept the pericardial sac fairly full in spite of sponging, and the pericardium itself was

## INTRAPERICARDIAL TRAUMATIC HEMORRHAGE

inspected for the bleeding vessel. None was discovered, so the heart was lifted out of the pericardial sac and then the true state of affairs was disclosed. My fingers felt a roughened area on the posterior aspect of the heart, and on closer inspection of the heart itself, the part presenting anteriorly was seen not to be the right, but the left ventricle. The rough area on the posterior aspect of the heart was situated then in the right ventricle. The hemorrhage was coming from this wound, but how the wound could be situated on the posterior aspect of the heart, leaving the front untouched, was more than I could figure out at the time. However, as the patient's condition was very bad, I tried to sew up the perforation, but found that every attempt to lift up the heart to expose the posterior aspect was followed by a stopping of the cardiac pulsation. A similar result was produced when the heart was rotated. An attempt was now made to pass the suture without seeing the perforation, guiding the needle by a finger held against the opening. This was found to be impossible, as the space between the pericardium and the heart posteriorly was too narrow, and the constant motion of the heart itself baffled any attempt to place a suture unguided by the eye. One who has never seen the movements of the heart in the living body has little conception of the wide excursions that it makes, and the great difference in size the heart shows in extreme systole and greatest diastole, and the accurate placing of the suture was found to be impossible without lacerating the heart wall still further. The pericardium was then packed with gauze and the patient removed from the table, as he was moribund, death occurring half an hour later.

The postmortem by Dr. Coe disclosed a curious and interesting condition. The heart was seen to be rotated on the longitudinal axis, so that the right ventricle presented posteriorly, and showed a perforation about one-half inch long extending into the cavity of the ventricle. The left ventricle formed the anterior aspect of the heart, and the heart was dislocated slightly to the right. A pneumothorax was present. There was no other wound of the heart, and the only explanation which I can offer is that after the heart was perforated the pneumothorax not only pushed the heart to the right, but rotated it on its axis, swinging it over as a hinged door changes the relation of its surfaces to the room into which it opens.

In the last year or two I have had occasion to make a very thorough review of the literature of the surgery of the heart, and I have nowhere encountered a similar experience.

A critical review of these two cases has led me to the following conclusions. The method employed in forming the osteomuscular flap, while giving a splendid exposure of the operative field, necessitated fracturing the ribs. This in itself does no harm, but should only



be practised in those cases in which a left pneumothorax can be definitely diagnosed, for the danger of tearing the pleura is very great. It did not occur in either of these cases, but the possibility of its happening should be borne in mind. The after-results of the method, as shown in the case which recovered, have left nothing to be desired. Union occurred promptly, was firm, and no deformity resulted. Subperiosteal division of the ribs would theoretically be more desirable than fracture, but it consumes time, and time is one of the first considerations in this operation, for the sooner the heart is relieved of the intrapericardial pressure the brighter are the chances of success. Both these cases showed definite symptoms of heightened intrapericardial pressure, which were before operation attributed to the pneumothorax. That this was an error was conclusively demonstrated when the pericardium was incised, for an instantaneous and pronounced change for the better was observed in the respiration, cyanosis and character of the pulse. I have reported a similar experience, even more pronounced, in a case of suppurative pericarditis with a very irregular pulse. This irregularity disappeared suddenly and permanently when I incised the pericardium, thus relieving the pressure.

Both of these patients received ether by the drop method, and no difficulties were experienced in its use. The intratracheal method might be employed with great advantage here, and has been used in a recently reported case from the war zone, but we must not overlook the main factor which is producing the gravity of the symptoms in these cases, namely the heart tamponade, in which the intrapericardial pressure is in the excess of intra-auricular pressure. Consequently the sooner this is relieved the better will be the condition of the patient. The almost certain complication (in stab wounds) of a pneumothorax renders it very easy to attribute the profound respiratory disturbance to this and to overlook the cardiac condition which is really the cause. As I have shown in a recent paper it is extremely difficult to aspirate the pericardium without going through the pleura, therefore a stab wound will almost certainly damage it, and usually produce a pneumothorax.

Whether to close the pericardium or to drain it after these operations is still a matter of opinion. Certain it is, however, that a great number of the cases in which no drainage was used have recovered with no complications. I am further convinced, moreover, that the adhesions which must result from the use of a drain are a more certain evil than the merely possible occurrence of infection, which can be handled in an appropriate manner if the necessity should arise.

The following conclusions may therefore be drawn

1. There is practically in all cases of stab wound of the heart an accompanying injury to the pleura, usually resulting in pneumothorax

## INTRAPERICARDIAL TRAUMATIC HEMORRHAGE

2. Extreme symptoms of respiratory embarrassment should be considered as caused by the heart tamponade, and not by the pneumothorax alone

3 This tamponade must be relieved immediately

4 These cases stand ether anesthesia well

5 The incision used in these cases gives splendid access to the heart and gives perfect functional and cosmetic results

6 Drainage is not necessary, but the sac should be washed out before closing, preferably with salt solution

# SUBCUTANEOUS INJURIES OF THE LIVER

A REPORT OF TEN CASES

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OF NEW YORK CITY

(From the First Surgical (Cornell) Division of the New York Hospital)

THE liver, due to its position between the bony thoracic walls and to its almost complete fixation and slight elasticity, is particularly prone to be injured by many varying forms of violence. Ten cases of liver injury have come under the writer's care since January, 1908. Of these, nine cases were submitted to operation with two deaths. One was not recognized as a case of liver rupture except at the autopsy. Of the above ten cases one was a subcapsular hæmatoma, one a large hemorrhagic cyst, and the other eight were lacerations of the liver of varying degrees.

Rupture of the liver may occur spontaneously in carcinoma of that organ (Chiari)<sup>1</sup> or following pneumonia with pleurisy and pericarditis (Heinzleman),<sup>2</sup> but in the large majority of cases it is due to some form of trauma either as a result of direct violence over the liver proper, or by some form of indirect violence, such as a fall upon the feet, the head, or a blow on the left side.

Two varieties of liver rupture are recognized by Teirier and Auvray<sup>2</sup> (1) those in which the capsule of the liver is untorn, the injury being subcapsular, and (2) those in which both capsule and parenchyma are torn.

In the first we may have subcapsular hæmatoma due to the rupture of the small vessels between the capsule and the parenchyma with or without a rupture extending into the parenchyma, or there may be small hemorrhages deep in the parenchyma which do not appear on the surface (hepatic apoplexies). The latter may form a cyst or cysts of varying sizes, the blood remaining fluid for some time, or the hæmatoma may become infected and form single or multiple abscesses. Of my cases, Case I represents the type of subcapsular hæmatoma, Case II that of a subcapsular hæmatoma of some size forming a blood cyst which amounted to 82 ounces in an aspirating bottle.

The second group includes small shallow tears through the capsule into the parenchyma up to the complete severance of large portions or even an entire lobe of the liver.

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<sup>1</sup> Quoted by Fraenkel, *Beit z klin Chir*, 1901, Bd 30, p 418.

<sup>2</sup> *Revue de chir*, 1896, No 10, 1897, No 1.

## SUBCUTANEOUS INJURIES OF THE LIVER

Of the cases reported here all involved the right lobe, five involved the concave, two the convex, and one extended through the free edge on to both concave and convex surfaces. In two the tears completely severed the right lobe (one case still had a portion of the parenchyma and capsule on its anterior surface, but for all practical purposes it completely detached a large portion of the right lobe), while the remainder were larger or smaller rents extending to varying depths into the liver substance. The two extensive cases died, all the tears of lesser magnitude submitted to operation recovered.

Rupture in this series occurs most frequently on the concave surface of the liver and less frequently on the convex side. The right lobe was more commonly involved than the left.

Tidley<sup>7</sup> states very aptly that the danger lies not so much in the injury to the liver as in its results and their complications, namely, hemorrhage, infection, peritonitis, ileus, death due to the escape of large quantities of bile, the forcing of the liver tissue into the veins forming emboli which localize in the lung capillaries (Marshall, Hess, and Zenker), or which localize in the entrance of the inferior vena cava into the heart (Schmorl).<sup>8</sup> Escape of bile into the peritoneal cavity or the loss of large quantities of bile causes death, as shown by Lachr, Postemski, Morris.<sup>9</sup>

Of the results of liver rupture hemorrhage is the most serious. In Fraenkel's statistics death resulted 69 times before twenty-four hours, and in 81 cases inside of forty-eight hours.

Of my cases, one, the unrecognized case, died from hemorrhage from three small tears in the liver on the convex surface of the right lobe, within twenty-four hours, and no other cause for death could be found at autopsy. In Case VI, in which the whole right lobe external to the gall-bladder fissure was separated from the liver, the child died from hemorrhage while the wound was being closed, and in Case IV death resulted from the effects of the hemorrhage twelve hours after the injury, although further hemorrhage did not occur after the operation.

Tillman<sup>7</sup> reports a case in which at autopsy three days after injury a large piece of liver was found torn from the surrounding liver tissue. The defect in the liver was found filled with blood clot, but no blood was found in the peritoneal cavity. He concludes that one only finds large amounts of blood if a large vessel is torn, a statement which Case X, in which the tears were shallow and showed no torn vessel of any size at autopsy, and Case V, in which the tear while long was quite shallow, but in both of which the belly was filled with blood, would tend to contradict.

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<sup>7</sup> Quoted by Fraenkel, loc cit.

<sup>8</sup> Quoted by Fraenkel, loc cit.

<sup>9</sup> Virch. Archiv, Bd 78, Hft 3.

Terrier and Auvray<sup>6</sup> consider the blood-vessels of any size as more resistant to injury than the liver tissue. The bleeding depends upon the physiological hyperæmia or anæmia of the organ. Podwyssozki<sup>7</sup> found, for example, that in animals deprived of food for from one to two days the liver became anæmic and contracted, and in such cases there was little bleeding from the cut liver surface. The amount of the hemorrhage depends upon the location of the tear, the hemorrhage being freer from the concave surface. The tear heals by scar tissue chiefly with some formation of new gall-ducts and undeveloped liver tissue (Ziegler)<sup>8</sup>

The symptoms of liver injury usually given include many phenomena. Since my cases represent a consecutive series only those which occurred in the series will be mentioned, with such reference to the missing ones as may give a clear understanding of the symptom complex.

Only nine of the cases here reported can be used for analysis, as Case II represents a later stage of one of the types of liver injury and no direct information of the conditions existing after the accident was obtainable.

Shock was present as an immediate symptom in all except one of the cases, *i e*, Case VIII, which came to the hospital between four and five hours after the injury. In the other cases shock was stated as profound in one, very severe in five, and extreme in two, who were unconscious upon admission.

Thole<sup>9</sup> describes a variety of shock which appears at the end of three or four hours as a result of hemorrhage, *i e*, a delayed onset of the shock. This was not present in my cases. In Case VIII, in which shock is specifically mentioned as absent, a statement is made that the boy "does not look sick."

The pulse was small, rapid, barely felt at the wrist in four cases, the patient pulseless in five cases, in one of which the heart sounds are mentioned as barely perceptible with the ear upon the chest. Bradycardia, described by Finisterre<sup>10</sup> as a diagnostic sign, did not occur in this series. The temperature was subnormal, 97° F in three cases, normal, 98.6° in four cases, 99° in two cases. The respiration was rapid, shallow, gasping in character, and costal in type in eight cases.

*Signs of Hemorrhage*—The statement that the patient was pale, eyes sunken, extremities cold, appears in practically all the cases. The essential feature of this symptom is, however, the presence of dulness in the abdomen. This is mentioned as absent in two cases. In Case I this observation was correct. In Case X it was obviously an error in

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<sup>6</sup> Rev de chir, 1896, No 10, 1897, No 1

<sup>7</sup> Quoted by Fraenkel, loc cit

<sup>8</sup> Lehrbuch d path anat, 1898

<sup>9</sup> Neue Deutsch chir, Bd 4, 1912

<sup>10</sup> Deutsch Zeit f chir, Bd 121, 1913, p 520

observation, as the abdomen was full of blood at the autopsy. Dulness was stated as being present in both flanks and movable in six cases. In one case dulness was found in the right flank, which was not movable, a correct observation, as the quantity of blood in the cavity was not large and most of it was confined to the right flank (see Case VIII). The liver dulness was stated to be normal or unchanged in six cases. In one it was mentioned as being diminished, and in two no mention was made of it.

Vomiting as an early symptom was mentioned as having occurred in four cases and was not mentioned in the remainder. It was not copious and contained only the stomach contents.

*The Character of the Abdomen*—The abdomen was stated to be flat or retracted in eight cases, distended or full in one case. Total rigidity of the abdomen occurred in eight cases. In one case the rigidity was present in the upper half and the lower abdomen was soft. Tenderness was noted as most marked over the whole abdomen in five cases, over the right upper half of the abdomen in two cases, over the right upper rectus in two cases.

Pain was noted as a marked symptom in all except the two cases which were unconscious (Cases III and X). Referred pain was noted in three cases (Cases VII, VIII and IX), and in these cases was referred to the upper right scapular region. Bimanual pressure over the liver region increased this pain. It is interesting to note that the location of the liver rupture differed in all three of these cases. In one the laceration was on the concave surface of the right lobe running from behind forward; in one the liver tear involved the free edge of the right lobe well down into the flank and extended an equal distance upon the convex and concave surfaces, and in the third the lesion consisted in multiple tears upon the convex surface of the right lobe about four fingers' breadth from the free edge.

Jaundice did not occur as an early or late symptom in this series. Edler states that jaundice may appear as a primary jaundice two, three, or four days after the injury, as an absorption jaundice from the bile in the peritoneal cavity, or later as a secondary jaundice as a result of hepatitis, liver abscess, etc. One of the cases in this series developed a subdiaphragmatic abscess during his convalescence, but at no time did he show any evidence of jaundice.

The urinary findings in this series are chiefly post-operative ones and show nothing of any significance. Bile was not present in any of the specimens examined.

The blood examinations are not recorded in four of the cases. They were doubtless made, but being emergency cases were not immediately recorded, and hence probably forgotten later. The other cases show nothing of any moment except the early increase in the leucocyte

count, which was highest in Case IX, submitted to operation about six hours after the injury

Hæmoglobin	Leucocytes	Differential
	12,000	
95 per cent	10,000	77 per cent
	24,000	84 per cent
	50,000	89 per cent

*The diagnosis* of liver rupture offers many difficulties. Didactically it is easy to differentiate between a superficial contusion of the abdomen and an internal injury, but practically it is quite difficult to determine the nature of a given abdominal injury at that early stage which renders operative interference of value, as Madelung<sup>11</sup> has pointed out.

The evidences of a liver injury are those of a severe internal injury and may be considered as presumptive and positive. Under the presumptive evidence one must consider the nature, force, and site of application of the violence. The passage of a heavy vehicle over the upper part of the abdomen (Cases I and IV), a kick in the upper abdomen by a horse (Cases III and IX), a fall from a height striking on the right side against a fire escape, chair, etc (Cases V and VII); a severe blow over the right hypochondrium (Cases II and VI) should be sufficient suggestion that one might expect some severe internal injury.

The presence of a local superficial contusion, if it means anything, is usually negative evidence. There were no signs of superficial injuries in any of my cases. In children especially the clothes are more trustworthy than the evidence of bystanders, and will show in most cases the mark of a horse's hoof (Case III), or the mark of wheels (Cases I and IV).

Under the more or less positive evidence of severe internal injury due to liver injury are shock, which is usually profound, signs of hemorrhage as evidenced by skin pallor, an early leucocytosis, and dullness in the flank, pain in the abdomen with tenderness, and on bimanual pressure over the liver with radiation of the pain to the right shoulder and rigidity of the abdominal muscles, especially over the upper recti. The abdomen is flat, the respiration shallow and costal in type.

The early hæmoglobin estimations do not, as a rule, show any marked change. In fact, a number of hours must pass before any change becomes definite and a lowered hæmoglobin estimation is not a dependable symptom.

Given presumptive evidence sufficient to consider internal injury a factor in the case when our positive evidence is meagre or unsatisfactory, the treatment should be prompt surgical intervention. Delay avails nothing. If there is no injury, or if it is merely a subcapsular hæmatoma, recovery occurs. If a liver rupture is present and the ab-

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<sup>11</sup>Zeit f klin chir, Bd 17

## SUBCUTANEOUS INJURIES OF THE LIVER

domen is full of blood, recovery depends upon the extent of the liver injury and the time of surgical intervention. Late operations have a much higher mortality. Thole's<sup>12</sup> statistics with regard to this fact are illuminating. He divides the time of operation into four periods. First period, up to six hours after injury, gave 39.5 per cent mortality; second period, seven to twelve hours after injury, gave 50.4 per cent mortality; third period, thirteen to twenty-four hours after injury, gave 66.6 per cent mortality; fourth period, later than twenty-four hours after injury, gave 86.3 per cent mortality.

For prognostic purposes cases of liver injury must be divided into three groups. First, the subcapsular injuries which recover unless complicated by infection or by cyst formation when the prognosis becomes that of those conditions. Second, injuries extending through the capsule into the parenchyma. Here we find one group (*a*) in which the liver is torn in half and a large fragment separated from the remaining liver tissue, which type is invariably fatal, another group (*b*) in which the prognosis is so intimately connected with the time of operation that one might fairly say that those cases operated upon early nearly all recover and all others die. Third, that group of cases in which other viscera and the liver are injured, which cases are more serious and have a higher mortality.

Edler,<sup>13</sup> in a statistical study of non-operated cases, the diagnosis being clinical, found that death occurred in 78.2 per cent of the cases uncomplicated by other visceral injury. Douglas, in the complicated cases submitted to operation, collected from the literature, puts the mortality at 41.4 per cent, but believes that the true mortality is somewhat higher. Fraenkel<sup>14</sup> reports two cases of his own and twenty-nine cases from the literature submitted to operation within the first three days. Of these seventeen were cured, fourteen died. Of the fourteen fatal cases ten were complicated by injury to other organs, and, if we eliminate these, we have a percentage mortality of 19 per cent plus and recovery in 80 per cent.

Statistical studies which do not specify the extent of the liver injury and the time of operation can give but little light upon the real results of liver injury. Of the nine cases in this series submitted to operation, seven recovered and two died, a mortality of 28.5 per cent for the series. Submitting these cases to further analysis two are found in the first group above mentioned, *i e*, the subcapsular injuries. Case I would undoubtedly have recovered without operation, and Case II represents the after-effects of a subcapsular hemorrhage of four months' duration. The cases are not sufficient for this type to give any real insight into the mortality for this type.

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<sup>12</sup> *Neue Deutsch. chir.*, Bd 4, Stuttgart, 1912.

<sup>13</sup> *Loc. cit.*

<sup>14</sup> *Loc. cit.*



Eight cases are found in the second group above mentioned, *viz*, tears of the capsule and parenchyma. Seven were submitted to operation and one passed unrecognized as a liver rupture until the autopsy. Further analysis shows that these seven operative cases should be divided into two groups discussed in the earlier portion of the paper, *viz*

(A) Severe liver injury separating a large portion of the liver more or less completely

Two cases. Operation within an hour after injury with two deaths. Mortality 100 per cent.

(B) Liver lacerations of varying degrees extending into the liver substance for varying depths

Five cases, five operations. Two cases one hour after injury. One case three and a half hours after injury. Two cases within six hours after injury. Five recoveries.

The unrecognized case would come into this group and gives a hundred per cent mortality for non-operative interference for the group.

Thole's<sup>15</sup> statistics for 260 cases of subcutaneous liver rupture submitted to operation are as follows

1—Simple liver rupture, 188 cases with 83 recoveries and 105 deaths, a percentage mortality of 55.85 per cent.

2—Complicated liver injuries. In this group he includes both severe liver injuries as well as injuries to other viscera, which rather confuses the issue. He reports 59 cases with 14 recoveries and 44 deaths, a percentage mortality of 74.6 per cent for one subdivision. Under his subdivision (b), which includes small liver injuries with severe injuries to other viscera, he reports 14 cases with 3 recoveries and 11 deaths, a percentage mortality of 78.6 per cent.

It is difficult to establish a basis of comparison in the face of these varying methods of classification. Practically all his cases grouped under his second subdivision I would group under my Group 3, and would expect a very high mortality for this group because of the rapidity of the hemorrhage.

With regard to the treatment of the liver injury proper, many methods for arresting hepatic hemorrhage have been advised, *viz*, packing, suture, the actual cautery, steam, digital compression of the liver hilus (Tuffei), compression of the ligamentum hepatoduodenale by a special clamp (Baron),<sup>16</sup> etc.

In the cases reported here there was no active hemorrhage at the time of operation which could not be stopped by packing the liver wound with a long-tailed cigarette gauze drain, which was then brought out through a stab wound in the abdominal wall directly over the liver.

<sup>15</sup> *Loc cit*

<sup>16</sup> *Zentralbl f klin chir*, No 49, 1910, p 1547

## SUBCUTANEOUS INJURIES OF THE LIVER

wound The drain was left in place until it became loose, about the seventh day, when it was gradually shortened day by day, until it was removed Suture would not have been practical in any of my cases, since the abdominal incision and the liver wound were not so situated, the one to the other, as to render suture possible, except under time-consuming difficulties In Case VIII a piece of omentum was used to plug the rent in the liver, which was not large, and the hemorrhage was completely stopped by this means

With the other forms of treatment for liver lacerations the writer has had no experience, inasmuch as gauze packing was sufficient for all the cases under the writer's care, except the one in which the omentum was used The rapidity with which the gauze can be inserted is also a matter of some importance, since patients with liver injury do not bear any long-continued operative procedure due to the collapse following the rapid bleeding from the torn liver surface

The post-operative course is usually stormy Ileus and pain have been prominent symptoms in this series, both of which were relieved by enemata and by an electrical pad placed over the abdomen One case developed a supradiaphragmatic abscess due probably to the blood which was not removed at the first operation, and this abscess was subsequently opened and drained and the patient made a very satisfactory recovery In all of the cases at the New York Hospital the fluid blood was removed by the Kenyon-Pool aspirating device by an assistant while the exploration and treatment of the liver wound was being handled by the operator This suction device lessens the time of operation, makes the traumatism less, due to the ease with which the blood can be sucked out of the abdomen, and, due to the more complete removal of the blood, decreases the amount of the post-operative reaction which results from any quantity of blood left in the abdomen It will be noticed in the case reports that saline irrigation was practised in the earlier cases and the belly filled with saline solution during the closure of the abdomen This was abandoned as an unnecessary procedure when it was observed that patients with hemorrhage from other conditions who had not been irrigated, etc., had a less uncomfortable and less stormy convalescence.

### TABLE I SUBCAPSULAR INJURIES

CASE I—Stephen G., aged seven, admitted to Bellevue Hospital (Second Surgical (Cornell) Division) April 26, 1909, with a history of having been run over by a delivery wagon just previous to admission There were marks of wheels on the clothes just over the abdomen The patient was pale, pulse small, barely felt at the wrist, respiration rapid and shallow Temperature 98.6° F. Extremities cold Abdomen flat and rigid, tenderness most marked over the upper right rectus No dulness in flanks

Operation one-half hour after the injury Median gastric incision No blood in cavity Subcapsular hæmatoma on the convex surface of the liver just to the right of the falciform ligament Measures 6 inches by 1 inch Tier closure of abdomen Reported well and without symptoms six months after the injury

CASE II—Wm G M, aged thirty-two, admitted to the New York Hospital (Dr Conner's Service) December 3, 1908 He complained of swelling in the upper abdomen, weakness, pain in the abdomen radiating to the left side and into the back below the left shoulder blade, and blood in the stools

The present illness began about four months before admission (July, 1908) The patient while at work was struck a severe blow upon the stomach by a truck stay Following the blow he was nauseated, felt weak, and had severe abdominal pain, for which he consumed large quantities of whiskey He was unable to work, as the pain was aggravated by moving, coughing, vomiting, or deep breathing About two months after the injury the pain became more intense, was localized definitely in the epigastrium, and the patient could neither lie down nor sleep Early in October, about three months after the injury, a swelling appeared which has steadily increased in size since then Throughout he has had morning vomiting which has never contained blood

*Examination*—The general examination was negative The abdomen is markedly swollen in the epigastric region, where there is a large tender mass extending from the costal margin almost to the navel and laterally about five inches to each side of the median line The mass seems elastic, semifluctuant and quite superficial It is continuous with the liver dulness A test meal was negative The stools contained blood once Hæmoglobin 72 per cent, leucocytes 8000, polymorphonuclear 74 per cent The temperature ranged from 99° to 101° F

The patient was then transferred to the surgical side (Dr Hartley's Service)

*Operation* (December 16, 1908)—Median epigastric incision over the centre of the mass, exposing a large cystic mass projecting from the liver surface On aspiration with a trochar 82 ounces fluid blood were obtained, the removal of which left a large cavity which extended deeply into the surface of the liver This cavity was packed with two large one-yard gauze rolls The other viscera felt normal His convalescence was uneventful and he was discharged from the hospital at the end of six weeks Four months after the operation he was reported as free from pain His stools were normal and he had again resumed work

This case presents many features of interest, viz, the long period of symptoms, the gradual appearance of the swelling, the marked alcoholic history (he was under observation and treatment throughout the period of the above illness for an obvious alcoholic gastritis), the size of the blood cyst, and the long period (five months) which elapsed between the injury and the operation

## SUBCUTANEOUS INJURIES OF THE LIVER

### TYPE II TEAR OF BOTH CAPSULE AND PARENCHYMA

(A) *Cases with complete severance of a large portion of the liver* (Two cases, two deaths, mortality 100 per cent).

CASE III.—Joseph P., aged two and one-half years, admitted to Bellevue Hospital (Second Surgical (Cornell) Division) May 4, 1910, with a history of having been knocked down and trampled upon by a horse one-half hour before admission.

*Examination*—Child in marked shock, extreme pallor of face and lips, skin covered by cold sweat. Complaints of pain and thirst. Pulse not felt at the wrist, heart sounds weak. Right thigh is held flexed. Respiration is gasping in character, costal in type. Abdomen seems full and rigid. There is tenderness, especially over the whole right half. There is dulness which is movable in both flanks.

*Operation* (one-half hour after injury).—Intravenous saline infusion was begun and continued throughout the operation, patient receiving 36 ounces. Median epigastric incision. The belly was filled with blood. The liver was pale in color. There was a complete tear through the right lobe just external to the gall-bladder fissure completely separating the liver into two portions. The torn surface was not bleeding. The child's condition became so grave that the belly was closed just as the child died.

CASE IV.—Gertrude S., aged twenty-two, admitted to the New York Hospital, January 9, 1915, with a history of having been run over by a truck twenty minutes before admission. The patient was semiconscious and in great shock. Her face was pale, eyes sunken, lips cyanosed, extremities cold, and she was covered by a cold sweat. The pulse was not felt at the wrist and heart sounds were not audible. Temperature 98° F. The abdomen was flat and rigid in the upper half, especially on the right side where there was some tenderness. There was movable dulness in both flanks, but no change in liver dulness.

*Operation* (within an hour after injury).—The patient was given 800 c.c. saline solution intravenously. The feet were elevated and the extremities bandaged. After the above preliminaries the patient became conscious and a good pulse was obtained at the wrist. Examination at this time seemed to show that most of the fluid was in the left flank, although bimanual pressure over the liver caused the patient the most pain. Ether was the anæsthesia. A four-inch median incision was made. The belly was filled with blood. There was a large rent in the under surface of the right lobe of the liver which divided the liver in half except for a small portion of the capsule and the parenchyma over the anterior surface and dome of the liver just to the right of the falciform ligament. From this rent active hemorrhage was taking place. The rent in the liver was packed with gauze, which apparently controlled the hemorrhage. The wound was closed and the patient left the operating table in good condition. She gradually grew worse, however, and died twelve hours after injury.

*(B) Cases with varying degrees of liver lacerations*

CASE V—Elias L., aged fourteen, was admitted to Bellevue Hospital (Second Surgical (Cornell) Division) in July, 1908, with a history of having fallen six stories from a roof, striking on his right side against a fire escape on the way down and landing on the right side. He was in extreme pallor and shock. His respiration was shallow and rapid and there was no radial pulse. Temperature 99° F. There were no signs of external injuries on the abdomen. The abdomen was flat and everywhere rigid, especially so in the right hypochondrium, where it seemed most tender. There was dulness in both flanks which was movable. The right thigh was flexed and the patient lay on his left side.

*Operation* (Begun One Hour after Admission) —A median incision was made. The belly was full of blood. There was a laceration three inches long and a half inch deep on the concave surface of the liver just mesial-wards from the gall bladder. There was no visible bleeding from the torn surface at operation. Gauze cigarette drain packing. Saline irrigation and the belly was closed full of salt solution. The foot of the bed was elevated, recovery was uneventful, and the patient was well six months after the operation.

CASE VI—Joseph M., Italian, aged forty-five, was admitted to the New York Hospital, August 26, 1909, with a history of having been struck in the upper abdomen by a heavy piece of lumber. Following the blow he had pain in the abdomen and felt weak and sick. He was brought to the hospital in shock. The pallor was marked, pulse not felt at the wrist. He was covered by a cold sweat, and respiration was gasping and costal in type. Examination showed no visible superficial contusion of the abdomen. The abdomen was retracted and hard as a board, with general abdominal tenderness most marked in the upper right quadrant. Bimanual pressure over the liver caused pain referred to the right scapular region. There was dulness in both flanks which was movable. The liver dulness was diminished. The temperature was 98° F, white cells 12,000 with no differential.

The operation took place three and a half hours after the injury through a median incision. The belly was full of blood. There was a laceration on the concave surface of the right lobe of the liver well down in the flank running from behind forward. There was a ragged wound admitting four fingers for about two inches. No oozing was visible. A large cigarette gauze drain was placed through the stab wound in the flank. Irrigation and removal of clots. The belly was closed full of saline solution. The foot of the bed was elevated, proctoclysis was given. The subsequent pain distention was marked. There was more on the third day. The recovery was uneventful. The drain was removed the eighth day. The patient remained eighteen days in the hospital. During that time his temperature was never above 100.5° F. The patient was well one year after the operation.

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CASE VII—William M., colored, aged twenty-six, was admitted to the New York Hospital suffering from severe pain over the right ribs and abdomen. His history was that he had fallen down twelve steps, striking on his right side against the edge of a chair. He was temporarily unconscious, but came later to the hospital in a cab. The patient showed signs of shock with marked pallor. He was covered with cold sweat, his pulse was small, rapid and easily compressible. Respiration was rapid, shallow, and costal in type. Examination of the abdomen showed it to be retracted with no respiratory movement. There were no signs of external injury. The abdomen was everywhere rigid. There was tenderness over the right hypochondrium. On bimanual pressure over the liver, the patient complained of pain over the eleventh rib behind and in the scapular region. There was liver dullness to the costal margin with movable dullness in the right flank. His temperature was 98.6° F., rectal, white cells 10,000, polymorphonuclear 77 per cent., blood-pressure 95.

*Operation (One Hour after Injury)*—Median incision. The belly was full of blood. There was a laceration of the free edge of the right lobe of the liver well down in the flank extending about three inches on the convex and three inches on the concave side at the level of the liver wound. Irrigation and removal of clots. Closure of anterior wound and belly full of salt. There was subsequent pain, with distention for two days, finally relieved by a movement of the bowels. The recovery was uneventful. The drain was removed on the seventh day. The patient remained in the hospital eighteen days. During that time his temperature ranged about 101° F., falling on the eighth day.

CASE VIII—Louis R., aged ten, was admitted to the New York Hospital, October 13, 1914, suffering from epigastric pain and vomiting. His history was that on the day of admission, while pushing a stick along the slot of a trolley track, the stick slipped and he fell upon it with some force, striking his abdomen halfway between the xiphoid and the umbilicus in the midline. There was severe pain. He was breathless and unable to move for a few moments. He was able to go home and lie down. Soon after that he began to have severe pain just above the umbilicus and vomited. He was brought to the hospital. He did not seem acutely ill, but showed evidence of inconstant pain. His respiration was a little shallow and rapid. There was dullness in the upper right flank which was not movable. Upon examination the abdomen was flat, slightly retracted and the respiratory excursions diminished. The upper abdomen was rigid, the lower half fairly soft. The rigidity was most marked over the epigastrium. There was tenderness over the entire upper abdomen, maximum in midline, half way between xiphoid and umbilicus. White cells 24,000, polymorphonuclear 84 per cent.

The operation was exploratory laparotomy and repair of the liver, five hours after the injury. A high median incision was made. On opening the peritoneum there was fresh blood in the

upper abdomen apparently pocketed beneath the liver. Exploration of the stomach and duodenum was negative. On the under surface of the liver at the junction of the right and left lobes there was a stellate rupture, its longest tear one and a half inches. Hemorrhage was not active. The omentum was brought up and plugged into the laceration. This was fixed into position by suture to the posterior border of the falciform ligament. Tier closure of the abdomen. No drainage.

CASE IX —Patrick McG, aged fifty-four, stableman, was admitted to the New York Hospital, June 17, 1915, with a history of having been kicked in the abdomen by a horse about two hours before admission. After the blow, which winded him, he felt well except for some pain in the upper abdomen, and started for home. After walking about four blocks he had sudden severe pain in his belly which doubled him up and made him feel sick. On admission to the hospital he was in extreme shock, covered with cold sweat, pale and quite restless. His respiration was shallow and costal in type. His pulse was rapid, small and of low tension. Temperature 98.6° F. On examination the abdomen was flat. There was no evidence of external injury. There was rigidity which was most marked in the right hypochondrium. General abdominal tenderness, especially over the right upper quadrant. Pain referred to the right scapular region on bimanual pressure over the liver. There was dulness in both flanks which was movable. No change in liver dulness. White cells 50,000, polymorphonuclear 89 per cent.

*Operation* (About Six Hours after Injury) —A four-inch right paramedian incision. The abdomen was filled with blood. On the anterior surface of the right lobe about four fingers from the free edge of the liver and equidistant from the falciform ligament were two irregular lacerations about two inches deep by three inches long, which were still oozing. The wound was packed with gauze. Tier closure of the abdomen. The patient's condition was critical throughout. Blood removed by Kenyon-Pool suction during operation. Patient was given proctoclysis and hypodermoclysis.

Twenty-four hours after the operation the patient's condition became satisfactory. Blood count hæmoglobins 50 per cent, red cells, 2,168,000, white cells, 15,500, polymorphonuclear, 96 per cent. The packing was removed the tenth day. The patient's condition remained satisfactory until July 4, seventeen days after the operation, when he evidently developed a pulmonary embolism with a rise in temperature to 101° F. This temperature continued for two weeks, ranging from 99.6° to 101.4°, when it became evident that the patient had a suppurating process somewhere. Aspiration of the chest in the subdiaphragmatic region gave negative findings. On July 26, thirty-nine days post-operation, there was an abscess in the liver region, and on July 28, the sinus was opened by Dr Farr and an abscess between the liver and the

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diaphragm opened and drained. Following this, the patient made a satisfactory recovery and reported well eleven months after the injury.

CASE X —William S., laborer, aged twenty-four, was admitted to the New York Hospital, December 8, 1909, in the early evening. He was found unconscious by the ambulance surgeons, and had been caught between an elevator and the floor. The patient's chest was covered by petechial spots, the face was suffused, and there was a bilateral subconjunctival hemorrhage. The patient was unconscious upon admission, in extreme shock, with a small, rapid, slightly irregular pulse. The heart sounds were normal.

Upon examination there were found fractures of the seventh, eighth, and ninth ribs (right). Breath sounds distant, abdomen flat, no dullness in the flanks, and the house surgeon who saw him thought it a chest injury. He was given stimulants, etc., but never really regained consciousness. The next morning the patient was moribund when seen. The abdomen was distended, liver dullness decreased, and he died about sixteen hours after the injury.

*Autopsy* (Number 4534) (December 12, 1909) —By Dr. Elser. Body of a man 180 cm. long, large well formed frame, good musculature, good nutrition, skin over entire body very pale. On opening the abdomen about 300 cc. partly fluid and partly clotted blood escaped mostly from the right side in the peritoneal cavity in front of the kidney. Liver normal in size, diffusely yellow in color, smooth surface, thin capsule. On the upper surface of the right lobe about 4 cm. to the right of the suspensory ligament there were three lacerations, the long axis of which corresponded to the long axis of the body. These were in line with one another separated by arcs of well preserved liver tissue. The lacerations were about 2 cm. long, edges finely granular, and were covered with fluid blood. On section through the lacerations no hemorrhage extravasations into the liver tissue were visible. On section of the liver as a whole the substance was friable, yellowish-red in color, with the lobules well defined. Cause of death. Rupture of liver, hemorrhage.



# TRANSPERITONEAL SIGMOIDOTOMY FOR THE REMOVAL OF TUMORS IN THE MUCOUS MEMBRANE\*

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THE large intestine and rectum are prone to the development of tumors of an adenomatous, papillomatous or fibrous character. Multiple adenomas, familiarly known as polypi of the rectum, multiple papillomas or intestinal warts, and an infectious type in which small mucoid growths develop as the result of an inflammatory process in the mucous membrane, form well-defined clinical groups. On exploration, the entire large intestine and rectum will often be found involved. A considerable percentage of persons suffering from these inveterate disorders eventually develop malignancy. When seen early, the malignancy is usually found confined to a single growth, but later a large number of the growths undergo malignant change, probably because of the seeding of small transplants from the original focus. However, I have observed patients who have had polyposis of the large intestine for years without the development of malignancy.

As to the cause of polyposis and allied conditions, there seems to be no well-defined knowledge, but there is an impression that the polypi are the results of transplants carried up and down the intestinal tract by normal and reverse peristalsis from a single primary growth. The mucoid growths have an infectious origin. Many patients become extremely cachectic as a result of the hemorrhages and exhausting discharges caused by these growths. For relief it occasionally becomes necessary to do a colectomy as far as the lower sigmoid. Later, by means of a snare, the cautery, fulguration or radium, the remaining growths are removed from the rectum and rectosigmoid. Soper has published an interesting report of a case of this description operated on by Bartlett.

In the frankly infectious cases which develop mucoid growths the infection will subside following an ileostomy (Brown) whereby the entire large intestine is put at rest for six months or more. Several patients have been cured in this way in our clinic, so that re-implantation of the ileum to the colon was not followed by a recurrence. Occasionally this method of treatment will prove efficacious and result in cure in polyposis. Therefore, before doing a colectomy, it is wise to do an ileostomy and wait some months to ascertain whether or not the polypi will disappear. In the meantime the rectum and lower sigmoid should be cleared of visible polypi, and the colectomy, if necessary, done as a secondary procedure. A complete ileostomy gives less annoyance than a colostomy, the stool soon becomes semisolid, is easily caught in a suitable container, and is nearly free from odor.

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## TRANSPERITONEAL SIGMOIDOTOMY

Localized polypoid, usually limited to one or two polypi of a fibrous character, is often found in the ampulla of the rectum. Such tumors become more and more pedunculated until they may be extruded from the anus with the stool and require replacement after each evacuation. A favorite seat of single polypi and localized papillomatous growths is in the lower sigmoid and rectosigmoid. When pedunculated, they can be removed through the sigmoidoscope by the cold wire. However, in this situation they are less frequently pedunculated, and may be completely sessile. Patients with

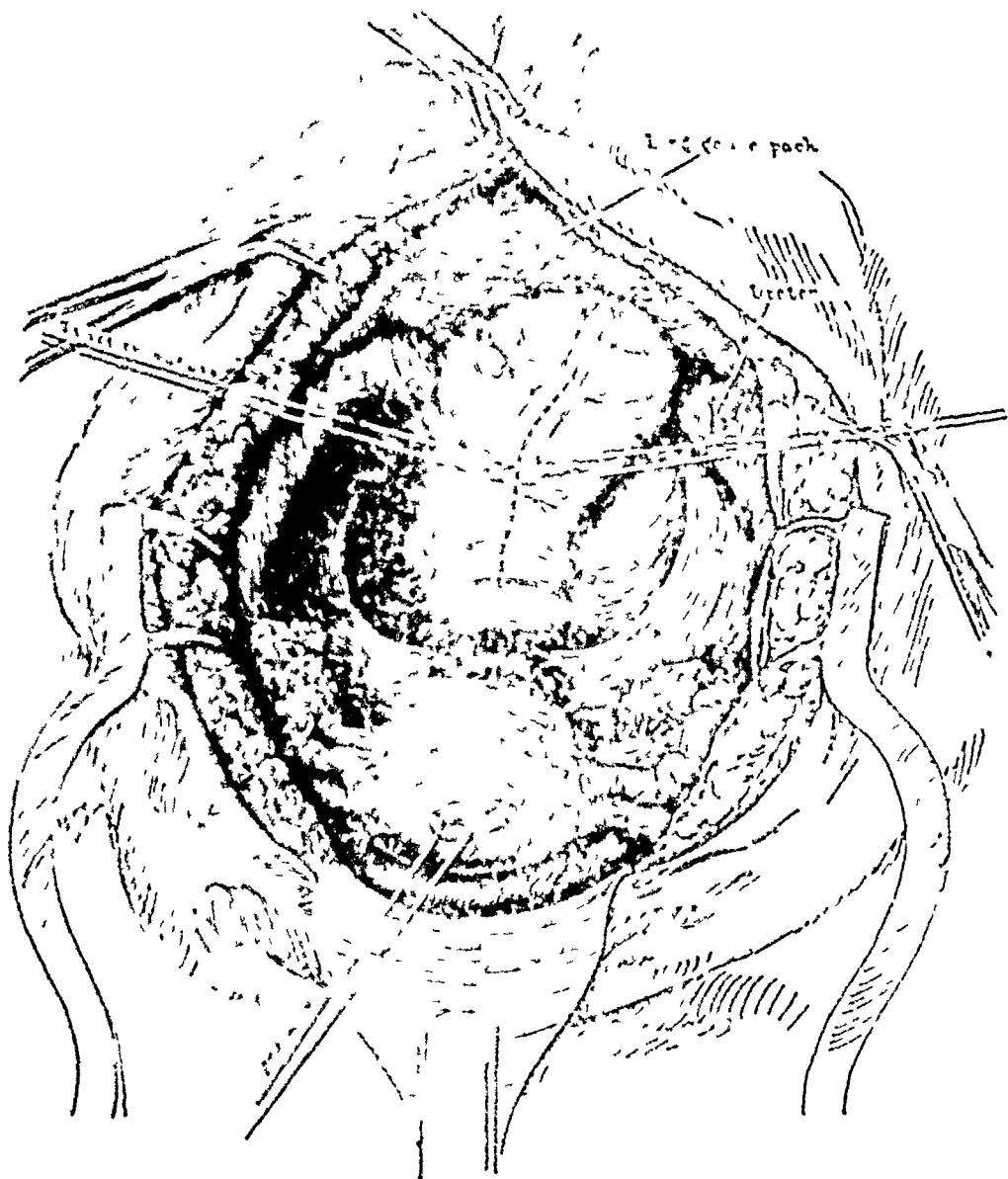


FIG. 1.—Exposure of lower sigmoid for removing tumor from within lumen. Dotted line shows proposed incision with traction sutures in place.

such growths have blood, mucus, and purulent discharges from the rectum and a sense of uneasiness and gas in the lower sigmoid, signs and symptoms which call for careful sigmoidoscopic examination.

The condition of the lower sigmoid and rectosigmoid is, in a way, somewhat similar to that of the ampulla of the rectum in its relation to the sphincter. The rectum proper begins at the middle of the third sacral vertebra and is derived from the cloaca, a highly differentiated part of the hind

gut At the juncture of the sigmoid and rectum in most persons (Jonnesco) there is a marked change in the mucous membrane and a very considerable narrowing Reeves, in a recent anatomical research on cadavers, found that this narrowing existed in 80 per cent and amounted to a constriction in 5 per cent

Attempts to remove sessile tumors located in the lower sigmoid, through the sigmoidoscope, are not unattended with danger, and perforation with



FIG 3 —Clamps catching normal mucosa Growth being burned off by cautery

FIG 4 —Continuous catgut suture placed around forceps, for closure of defect in mucosa (Pilcher method)

death from septic peritonitis as the result of such more or less blind procedures has been reported We have found transperitoneal sigmoidotomy a simple, safe and satisfactory procedure for the removal of these tumors A fragment from the growth, as exposed by the operation, can be removed for microscopic examination of the frozen section, so that operation can proceed more or less extensively as indicated Such an examination is satisfactory provided a piece of tissue is secured which is representative of the structure of the growth The tearing off of fragments from a growth for examination admits of the possibility of infection of the growth itself, which may result in invasion of the blood-vessels and lymphatics by cancer, if this disease be present, and lead to metastasis in the liver or glands



Fig. 2—Papulum (cyst) protruding through the opened sigmoid



## TRANSPERITONEAL SIGMOIDOTOMY

I always regret the necessity for excising a section from a doubtful growth unless the entire growth can be immediately removed if malignancy is established. Under any circumstances, the site from which the section was removed should be immediately sterilized with the cautery. It must be remembered, also, that unless the entire growth is given to the pathologist,

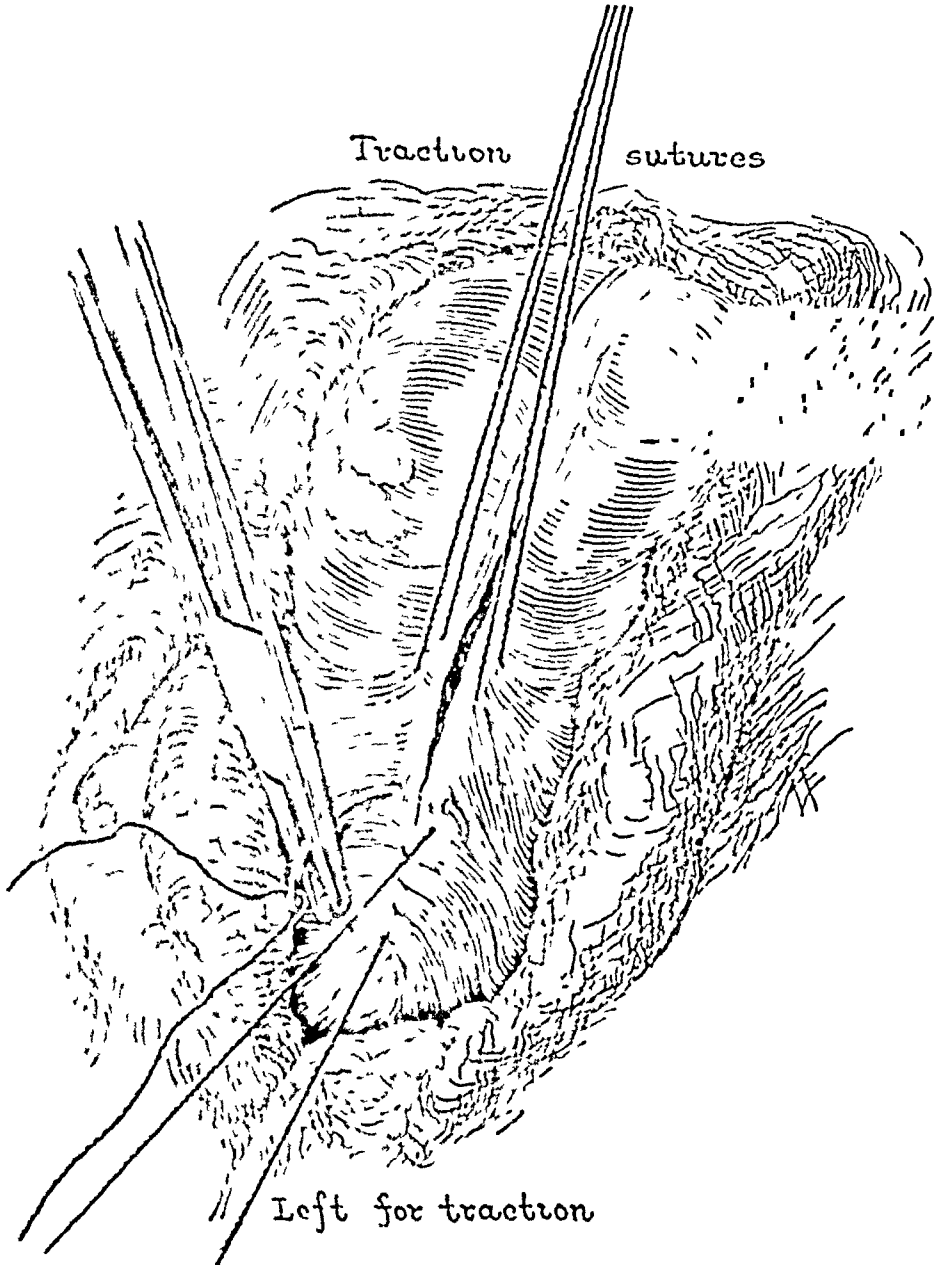


FIG. 5—Closure of working incision in intestine

a positive opinion is the only opinion of value, a negative opinion can be accepted only from an examination of the entire specimen.

The technic for removing such growths by transperitoneal sigmoidotomy is quite simple, and the illustrations which were made by Miss Fry from a recent case require little comment. The abdomen is opened in the midline, suprapubically, and a Balfour self-retaining speculum adjusted (Fig. 1). A moderate Trendelenburg with a pack gives good exposure. We now seldom use the exaggerated Trendelenburg, and in old and adipose persons we are especially cautious in this respect. The sigmoid is opened on the anterior

longitudinal band as nearly opposite the tumor as possible (Fig 2), and the tumor is exposed, drawn through, and double clamped (Fig 3) The growth is removed with the cautery and the defect closed from the mucous side by continuous sutures of chromic catgut after the method devised by Pilcher for the excision of hemorrhoids (Fig 4), and covered on the peritoneal side with a few interrupted silk sutures The incision in the sigmoid is then closed with continuous catgut and interrupted fine silk (Fig 5) We then pass a red rubber tube up into the sigmoid beyond the line of sutures and fasten it with a catgut suture to the anus, this is left *in situ* for a few days to prevent gas pressure We have never applied this procedure to frank malignant growths, but for growths similar to the papilloma shown in the drawings it will be found most efficient

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# THE VALUE OF THE X-RAY EXAMINATION IN CHOLELITHIASIS

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ONE may be very sure of a clinical diagnosis of gall-stones, but as a matter of fact, he cannot be *positive* that gall-stones are present unless he has seen them clearly in a rontgenogram. The statistics which I will present later on demonstrate that, at least in our work, we are able to show rontgenologically the shadows of gall-stones in approximately half of the positive cases.

Making the matter a personal one, I believe there are very few physicians with a clinical diagnosis of gall-stones who would consent to operation until after the Rontgen method had been tried if they realized that there was so favorable a prospect of gall-stone demonstration as one chance out of two. Of course, it is not to be understood for a moment that a negative Rontgen finding negatives the diagnosis, but a positive Rontgen examination clinches the diagnosis.

The demonstrability of gall-stones depends upon their composition. Gall-stones are composed mostly of cholestrin, a substance quite translucent to the X-ray. Gall-stones composed of pure cholesterol are practically invisible in the rontgenogram, but pure cholesterol stones are not so common as it was formerly supposed, for gall-stones nearly always contain some pigment, most likely calcium salts.

In a number of our cases, stones which had been removed at operation were subjected to an expert analytical examination. The stones were carefully weighed, the loss by drying at 100° C carefully calculated, the crude ash finally estimated, and from this the percentage of calcium oxide in relation to the total weight of the gall-stones. In the cases where gall-stones were present yet not recognized by our Rontgen examination, the highest percentage of calcium oxide in relation to the total weight of the stone was 0.30 per cent, that is, the highest proportion of lime oxide in relation to the total weight of the stone in the invisible calculi was less than one-third of one per cent. Of the positive cases, a number of analyses were made of stones which cast shadows very difficult to recognize, seen only upon very careful oblique illumination of the rontgenogram. The lowest proportion of calcium oxide in relation to the total weight of the stone in these cases of faintly visible calculi was 0.425 per cent, or a little less than one-half of one per cent.

From the rontgenographic standpoint, therefore, cases of cholelithiasis fall under three heads



1 Those where the gall-stones consist entirely, or almost entirely, of pure cholesterol, and are therefore invisible to the Rontgen ray, except in a few rare cases

2 Those cases in which the large lime content of gall-stones renders it almost impossible to overlook them, even during the most careless examination. Such stones as these can easily be made out fluoroscopically

3 Those cases in which the lime content of the stone is relatively low and the stone can be made out only by means of the most careful technic. It is in this third class that success or failure to secure as nearly as possible ideal rontgenograms marks the success or failure to a Rontgen diagnosis

In a series of one thousand consecutive bismuth meal examinations reported before the American Medical Association in June, 1913, I found forty cases of gall-stones with eight additional cases not examined with the barium meal. Cole, in February, 1914, reported a series of twenty cases of gall-stones out of five hundred consecutive gastro-intestinal examinations, the same percentage as in my series. Pfahler, from a large experience, is convinced that gall-stones can be found in about 50 per cent of the cases.

In autopsy statistics from nineteen American and European authors the average frequency of gall-stones is given as 5.9 in 18,892 necropsies. Hesse summarizes 17,402 autopsies done in ten years in Petrograd and found gall-stones in less than 3 per cent. The Johns Hopkins and Mayo clinics indicate that the figures are considerably below 10 per cent. Nevertheless, if we accept 10 per cent as being a sufficiently generous estimate of the frequency of gall-stones in our gastro-intestinal and genito-urinary cases combined, we would expect to find one in every ten, or one hundred in every thousand of our patients to possess gall-stones. As a matter of fact, we have found positive Rontgen evidence in forty-eight out of a thousand, the same percentage found by Cole and Pfahler. This is one way in which we arrived at our estimate that in 50 per cent of our cases gall-stones should be demonstrated rontgenologically.

In a series of more than five thousand consecutive patients examined for suspected disease of the gastro-intestinal tract, lumbar spine, or right kidney (these being the class of cases in which the gall-bladder region is automatically included) positive Rontgen findings were secured in 45 per cent of the cases. Estimating that probably 10 per cent of the patients had gall-stones, we, in this series, demonstrated 45 per cent of them rontgenologically.

In all the above, of course, the figures are only estimated. Accordingly, we took a series of three hundred consecutive abdominal cases, operated by Drs Kellogg, Harris and myself in the surgical wards of the Battle Creek Sanitarium, in which the surgical records show that the gall-bladder was examined at the time of operation and

## X-RAY EXAMINATION IN CHOLELITHIASIS

in which pre-operative X-ray study had been made. Gall-stones were found at operation in forty-one cases, and of these, twenty had been reported "positive" in the pre-operative X-ray study, making the Rontgen diagnosis positive in between 45 and 50 per cent of the cases. This, it seems, confirms the opinion that the Rontgen method is of considerable value in the search for gall-stones, although from 45 to 50 per cent of the gall-stones are of such composition that they cannot be shown roentgenologically.

The X-ray is of further value in gall-bladder diseases, in many cases demonstrating right upper quadrant adhesions with fixation and even sometimes the thickened gall-bladder. In the series of three hundred cases just cited, there were fifty-five cases of gall-bladder disease, some without stones, in which the pre-operative X-ray report showed evidence pointing definitely to gall-bladder disease. These cases have all been tabulated in a paper published in the *American Journal of Roentgenology* for May, 1916.

We can therefore conclude that it is definitely possible to show gall-stones in approximately 50 per cent of the positive cases and to show a gall-bladder lesion in 85 per cent of cases of gall-bladder disease.

Of course, from the X-ray examination it is not possible to make a positive declaration as to the absence of gall-stones. Many patients are not operated. Percentages on this point would be extremely misleading. Hence, I have refrained from expressing my negative findings in percentages, except to show the absurdity of such statistics. The point I wish to make is that gall-stones are demonstrable with much greater frequency than has until lately been conceded. The frequency with which stones may be shown is so great that I believe the time has arrived when the X-ray examination should be required in every suspected case.

# ACUTE PERFORATION OF GASTRIC AND DUODENAL ULCERS \*

WITH A REPORT OF 36 CASES

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THIS paper comprises a study of 28 cases of acute perforation of duodenal and 8 cases of acute perforation of gastric ulcers admitted to the Episcopal Hospital since 1908. Through the kindness of Dr H C Deaver and Dr R Neilson, I was permitted to operate upon eight of these cases. The stimulus that prompted me to study and report these cases was the wonderful immediate operative results of the cases reported by Dr John B Deaver of this city, and a careful study of cases operated upon and reported by Dr Gibson of New York.

Perforation of a duodenal ulcer is the most frequent, serious upper abdominal catastrophe we are called upon to treat. Notwithstanding this or the fact that so much has been written within the past few years on their experimental production, diagnosis and operative treatment, very few of our cases were referred to the hospital with the correct diagnosis. In the majority of instances, however, a surgical diagnosis had been made.

Since 1908, 157 cases of duodenal and gastric ulcer have been treated in the Episcopal Hospital, as 36 of this number were admitted with acute perforations, the chance, according to these statistics, of a simple ulcer perforating is 22 per cent.

Innumerable pathologic conditions have been mentioned as possible causes of duodenal ulcer, and in many ways have they been produced experimentally. Durante, in an article entitled "The Trophic Element in the Origin of Gastric Ulcer," mentions no less than seventeen ways in which they have been produced experimentally. The great majority of duodenal ulcers occur in men, and almost every case of the perforated ones, in fact, in every case in this series, man is the one affected. This seems to occur with too great a regularity to be a coincident. Is there an anatomic, histologic or physiochemical difference in the alimentary tracts of the two sexes, or does the abdominal type of respiration in the male favor the production of, or, when once formed, the perforation of a duodenal ulcer? In perforations of typhoid ulcer the proportion is almost, though not quite, as great in favor of the male sex.

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\* Read before the Philadelphia Academy of Surgery, March 5, 1917

## PERFORATION OF GASTRIC AND DUODENAL ULCERS

The diagnosis of a perforation of a duodenal ulcer is, as a rule, not difficult. The previous history of indigestion, the sudden, severe and excruciating pain in the epigastric region, sometimes followed by nausea and vomiting and the board-like rigidity of the upper abdominal muscles are usually present in every case. In a few of the cases, before the operation, we were unable to get a history of previous stomach trouble, but on closely questioning them after the operation we were able in all cases to elicit the fact that at times the stomach had given them some trouble.

It is surprising how infrequently patients suffering from an acute perforation of a duodenal ulcer exhibit symptoms of shock. Occasionally, however, it is a most serious factor. In one case of this series, a man sixty-two years of age who walked into the Receiving Ward, giving a history of a perforation a few hours previously, died an hour or two after admission from shock.

The absence of liver dulness is not regarded as a valuable sign. I am aware that its absence may be due to several causes, and also, for the sign to be of exact scientific importance, one should know the normal liver dulness of the patient in question. I believe, however, that it is of some value. In a case of acute hemorrhagic pancreatitis which I operated upon recently, with all the symptoms of an upper abdominal perforation, but having normal liver dulness, I made a diagnosis of probable duodenal perforation, but was not greatly surprised on opening the abdomen to find some other condition the cause.

To differentiate acute pancreatitis, perforation of the gall-bladder or that of a gastric ulcer from a perforation of the duodenum is often impossible. In some cases of appendicitis and in other inflammatory conditions within the abdomen that lead to a peritonitis, it may be impossible in the absence of a clear-cut history to make a correct diagnosis. Also in duodenal cases that have been perforated for several hours and have a diffuse peritonitis, unless you can obtain a clear history, it is only by the shrewdest guess that you are able to say other than that you are dealing with a perforative peritonitis. Besides the conditions mentioned above, the other causes we have encountered which atypically simulated an acute perforation of a duodenal ulcer were internal strangulated hernia, pneumonia, subdiaphragmatic pleurisy, visceral crises of tabes, gastritis, lead and ptomaine poisoning.

In the treatment of a perforation of a duodenal ulcer, all surgeons agree, with the exception of a few minor points in the technic, that the ulcer should be closed, whether or not a primary gastro-enterostomy should be performed is still a debatable question.

The best reasons advanced why a primary gastro-enterostomy should be performed are. To remedy any possible obstruction at

the pylorus resulting from encroachment upon the lumen of the duodenum, due to infolding of the ulcer, to obstructive oedema, that might follow shortly after operation, to late cicatrization, to place the duodenum and stomach at rest by dependent drainage and to bring about a cure by changing the chemistry of the stomach. Also, in cases of multiple ulcers, it acts as a cure and prevents complications incident to them.

The arguments against the performance of a primary gastro-enterostomy are: That it adds several minutes to the operation, it opens up the lesser peritoneal cavity to infection, and that a gastro-enterostomy does not always work the wonders it is supposed to, being very much like the little girl who "when she was good she was very, very good, but when she was bad she was horrid."

Primary gastro-enterostomy has nothing to do with the immediate results other than to forestall the possibility of pyloric stenosis. It, however, does render the patients more comfortable immediately following the operation, reducing the tendency to spit up or vomit. They are able to take substantial nourishment at an earlier date and thus hasten their convalescence.

Gibson, after a study of the end-results of fourteen cases, rejects primary gastro-enterostomy. He says, "I consider it unwise to do a gastro-enterostomy for a condition which is going to be cured anyhow." Case VII of my series is quite interesting and seems to bear this statement out.

C I, aged twenty-seven, diagnosis acute perforation of a duodenal ulcer, of six hours' duration. At operation a large chronic callous ulcer, nearly the size of a quarter, was found. This was closed by three layers of sutures. Cultures taken from the ulcer were negative, but from the upper and lower abdominal cavities diplococci were found. The patient, four weeks after the operation, developed a subdiaphragmatic abscess, for which he was operated by the transthoracic route with fatal result.

*Post-mortem*—Entire stomach and duodenum removed and showed nothing macroscopically, the duodenum appeared normal and there was no occlusion.

Our immediate results in cases where primary gastro-enterostomy was performed have been excellent and in those cases in which a gastro-enterostomy was not performed the mortality could in no way have been influenced by so doing, as these cases died of pneumonia, peritonitis and subdiaphragmatic abscess. Dr John B Deaver has had a most wonderful experience in acute perforations of duodenal ulcer and has operated upon 46 cases with but one death. In all but three of these cases he performed a primary gastro-enterostomy, truly a wonderful record and one that proves beyond doubt that the addition of a gastro-enterostomy does not increase

the mortality. Dr. Deaver's great skill and dexterity, however, make it possible for him to get results in a procedure of this kind far better than statistics usually show.

Our own experience in these cases with primary gastro-enterostomy has been excellent, having had ten without a death. I feel as if these cases were more or less picked ones, so hesitate to offer them, other than to show that primary gastro-enterostomy does not add to the mortality. Certainly two of the arguments against gastro-enterostomy, namely, the prolongation of the operation and the danger of spreading the infection, can be eliminated. If there is danger of immediate or late pyloric obstruction, or if there are other ulcers present, then certainly a primary gastro-enterostomy should be performed.

In gastric ulcers Balfour has suggested that the act of perforation has a curative feature, and on this basis has advised the use of the cautery on simple ulcers. The post-mortem findings in Case VII of my series certainly add weight to this suggestion.

In thirteen of our cases cultures were taken with the following results. In four a smear and culture both proved negative, in three, the smear showed pus cells, but a culture failed to show a growth, cultures in the remaining six showed diplococci in three, streptococci in one, diplococci and bacilli in one and bacilli in one.

In indurated ulcers where it is impossible to satisfactorily infold, I think it wise to place a small cigarette drain at this site. Regardless of laboratory results I believe it good practice to drain the pelvis, as one cannot tell at the time of the operation whether or not organisms are present in the soiled peritoneal cavity, and if they are, their number and degree of virulency. In early operations it is considered by some unnecessary to drain. I have been unable to convince myself of this, as in one case upon whom I operated four hours after the perforation, the culture showed diplococci. Drainage also permits the escape of the discharged gastric and duodenal contents which it was impossible to mop away at the time of the operation. Flushing of the abdominal cavity is, as a rule, not to be advised. It may, however, be necessary in early cases, where the peritoneal cavity has been flooded by a large quantity, and I may add, with large pieces of undigested food.

A study of the end-results has been gratifying but not convincing. I have seen twelve of the duodenal cases and two of the gastric ones who had had perforations. Seven of the duodenal cases had had an enterorrhaphy and a primary gastro-enterostomy performed and the remaining five an enterorrhaphy.

In questioning these cases (duodenal) most carefully, in only one, a case of simple enterorrhaphy, did I find a perfect cure. This patient had had absolutely no trouble with his stomach since the operation. In the other cases all had had some gastric disturbance. In the great majority of instances, however, it was due to specific

TABLE I  
AUTHOR'S CASES OF ACUTE PERFORATION OF DUODENAL ULCERS

Name	Age	Sex	Duration	Hours Perforated	Operation	Result	Cause of death
J H	53	Male	1 year	6 hours	Enterorrhaphy	Recovered	
H S	28	Male	2 years	4 hours	Gastro-enterostomy and enterorrhaphy	Recovered	
J M	38	Male	6 weeks	20 hours	Gastro-enterostomy and enterorrhaphy	Recovered	
J C	62	Male	5 years	13 hours	Enterorrhaphy	Recovered	
S S	23	Male	1½ years	8½ hours	Gastro-enterostomy and enterorrhaphy	Recovered	
W B	24	Male	6 months	9 hours	Gastro-enterostomy and enterorrhaphy	Recovered	
C I	27	Male	8 months	6 hours	Enterorrhaphy	Death	Subdiaphragmatic abscess
J A	49	Male	7 years	8 hours	Gastro-enterostomy and enterorrhaphy	Recovered	

TABLE II  
OTHER CASES OF ACUTE PERFORATION OF DUODENAL ULCER

Name	Age	Sex	Duration	Hours Perforated	Operation	Result	Cause of death
C S	44	Male	1 year	48 hours	Enterorrhaphy	Death	Peritonitis
J W	35	Male	1 year	8 hours	Enterorrhaphy	Recovered	
C J	35	Male	2 years	6 hours	Enterorrhaphy	Recovered	
S N	40	Male	4 years	12 hours	Enterorrhaphy	Death	Peritonitis
M F	24	Male	1 year	8 hours	Enterorrhaphy	Recovered	
G F	27	Male	1 year	7 hours	Enterorrhaphy and gastro-enterostomy	Recovered	
W K	52	Male	1 year	10 hours	Enterorrhaphy and gastro-enterostomy	Recovered	
W H	29	Male	8 months	48 hours	Enterorrhaphy	Death	Peritonitis
T K	26	Male	3 months	18 hours	Enterorrhaphy	Recovered	
J T	35	Male	3 years	6 hours	Enterorrhaphy and gastro-enterostomy	Recovered	
J McC	50	Male	8 months	27 hours	Enterorrhaphy	Death	Shock
R W	45	Male	2 years	8 hours	Enterorrhaphy	Death	Pneumonia
I B	22	Male	2 weeks	9 hours	Enterorrhaphy and gastro-enterostomy	Recovered	
E M	38	Male	5 years	6 hours	Enterorrhaphy	Death	Pneumonia
W S	35	Male	2 years	3 hours	Enterorrhaphy and gastro-enterostomy	Recovered	

TABLE III

CASES OF ACUTE PERFORATION OF DUODENAL ULCER ADMITTED TO THE HOSPITAL IN A MORIBUND CONDITION AND NOT OPERATED UPON

Name	Age	Sex	Duration	Hours Perforated	Operation	Result	Cause of death
I C	34	Male		30 hours		Death	Pertontitis
S McC	41	Male		48 hours		Death	Pertontitis
A S	62	Male		5 hours		Death	Shock
P H	35	Male		36 hours		Death	Pertontitis
H K	29	Male		72 hours		Death	Pertontitis

TABLE IV

ACUTE PERFORATION OF GASTRIC ULCERS

Name	Age	Sex	Duration	Hours Perforated	Operation	Result	Cause of death
H S	37	Male	4 years	12 hours	Gastrotomy	Death	Pertontitis
M	53	Male	1 year	6 hours	Gastrotomy	Recovered	
M G	21	Male	9 months	4 hours	Gastrotomy	Recovered	
E D	25	Male	2 weeks	8 hours	Gastrotomy	Recovered	
W F	53	Male	3 weeks	72 hours	Gastrotomy	Death	Pertontitis
W D	27	Male	1 year	6 hours	Gastrotomy	Recovered	
W K	35	Male	2 years	8 hours	Gastrotomy	Recovered	

Note.—In three of these cases the ulcer was situated very close to the pylorus

TABLE V

ACUTE PERFORATION OF GASTRIC ULCERS NOT OPERATED, ADMITTED TO THE HOSPITAL IN A MORIBUND CONDITION

Name	Age	Sex	Duration	Hours Perforated	Operation	Result	Cause of death
S C	25	Female		18 hours		Death	Pertontitis



causes, such as eating indigestible food, alcoholism, tobacco, etc. Several, and it was almost equally divided between the two types of operation, said they had to be very careful what they ate, and in two cases sodium bicarbonate was required to relieve attacks of hyperacidity. I selected four cases, two of enterorrhaphy and two of enterorrhaphy and primary gastro-enterostomy, for laboratory study. Only one, a gastro-enterostomy case, showed a normal acidity. The other three were above normal. An X-ray study showed one case, a simple enterorrhaphy, with slight gastric retention.

The post-operative advice is most important. Their mouths should be put in order, many of them have bad teeth, and they should be instructed what to, and especially what not to eat. Hot liquids, tobacco and alcohol should be forbidden. These instructions were given to nearly all of the cases on their discharge from the hospital. I was surprised, however, in making a study of the end-results, to find that only one or two had heeded the advice consistently.

To really know the true end-results these patients should be placed on the proper diet and they should live up to the instructions. They should also be carefully studied, as other conditions might be the cause for persistent or periodic gastric symptoms.

On the whole, the end-results of the cases studied in this series were quite good. It was, however, impossible after questioning them to say, "This is a case of simple closure," or "this is one on whom a primary gastro-enterostomy was performed."

# THE RELATION OF THE ILIOHYPOGASTRIC NERVE TO THE RADICAL CURE OF INGUINAL HERNIA \*

AN EXPERIMENTAL STUDY OF THE PHYSIOLOGY OF THE NERVE

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At a meeting of the New York Surgical Society, held November 11, 1914, Dr. Charles N Dowd<sup>1</sup> read a paper entitled "Preservation of the Iliohypogastric Nerve in Operation for Cure of Inguinal Hernia." This paper created an unusual amount of interest. Obviously, the necessity of preservation of any normal anatomical structure is so evident, that the plea which Dowd makes seems almost unnecessary. However, in the discussion of this paper, a divergence of views arose as to the reasons for preserving the nerve. Most of the members of the Society advocated the preservation of the nerve, because there did not appear any reason why it should be destroyed. A few members, notably Taylor, Vosburgh, Woolsey, and Moschcowitz, expressed their belief that that part of the iliohypogastric nerve exposed in the operation for the radical cure of inguinal hernia was purely sensory, and that its injury, more particularly its inclusion in the suture line, was occasionally followed by an annoying neuralgia.

Dowd<sup>2</sup> was evidently not convinced by the opinion of those who dissented from him, because less than a month later, namely at the December 9, 1914, meeting of the New York Surgical Society, he offered additional evidence to maintain his contention. In discussing the new evidence, I stated that the results of a few experiments I carried out did not agree wholly with the results of similar experiments in Dowd's hands. In order to convince myself of the soundness of my views, I have instituted a complete reinvestigation of this matter.

In preface I shall say that the attempt at solution of our problem was not as simple as it appeared to be at first blush. Indeed, I soon learned that the problem was so involved that it was impossible for me to carry it out without assistance. I therefore desire to express my

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\* Read before the New York Surgical Society, February 14, 1917

<sup>1</sup> Dowd ANNALS OF SURGERY, vol 1x1, p 204

<sup>2</sup> Dowd ANNALS OF SURGERY, vol 1x1, p 483

cordial appreciation of the service of my collaborator, Dr Harold Neuhoof, who carried out all of the animal experiments, and to other members of the Surgical Laboratory of the College of Physicians and Surgeons, notably Dr Clark and Dr Cunningham

The subject may be discussed from two viewpoints, namely (1) anatomy, (2) physiology

### (1) ANATOMY

A little reflection will very quickly show that the crux of the matter centres around the question as to whether that part of the iliohypogastric nerve which is ordinarily exposed in any one of the conventional operations for the radical cure of inguinal hernia is sensory, or motor, or mixed. Anatomists, however, are very obscure upon this point, most of them give but a very meagre description of the nerve, and not a single text-book is clear about the function of that part of the nerve which is under discussion. Finally, it must be also added, that the variations of the nerve, or, better said, the relationship between the iliohypogastric nerve and its two neighbors, namely, the twelfth intercostal and the ilioinguinal, are admittedly too numerous to admit generalizing deductions.

The consensus of opinion amongst anatomists appears to be that the iliohypogastric nerve is composed of nerve fibres which arise from the twelfth dorsal and first lumbar segments of the cord, and that frequently it arises in common with the ilioinguinal nerve. After emerging from the psoas muscle the nerve runs downward and forward in front of the quadratus lumborum, until it reaches the posterior aponeurosis of the transversus abdominis, and perforates the latter above the crest of the ilium. It then runs forward between the transversus abdominis and the internal oblique muscle, more or less parallel with its inferior fibres, and at a varying distance above the inferior edge of this muscle, until it reaches the linea semilunaris.

Most anatomists state that in the "posterior" part of its course, the iliohypogastric nerve gives off muscular branches to the transversus abdominis, and to the internal and external oblique, most anatomists are also agreed upon the fact that above the middle of the crest of the ilium, the nerve gives off a lateral cutaneous branch, which pierces the external oblique muscle, and descending over the crest of the ilium, is distributed to the integument over the gluteal region. After the main trunk of the nerve has reached the semilunar line, that is, slightly above the external inguinal ring, it pierces the aponeurosis of the external oblique, and is distributed to the integument covering the hypogastric region.

It is also conceded, that while the distribution of the iliohypogastric nerve as above outlined seems to be perhaps the one most frequently en-

countered, there are also numerous exceptions. The one most frequently met with bears a relation to the distribution of the ilioinguinal nerve, there appears to be a compensatory relationship between the two nerves, i.e., in some cases the terminal portion of the iliohypogastric nerve is small, and then the ilioinguinal nerve is large, and *vice versa*. There are also frequently found communicating branches between the two.

The description of the iliohypogastric nerve, as I have just given it, is, so to speak, a composite picture of the nerve, derived from my own studies and consultations with the best authorities. So much is conceded by Dowd. Thus far, therefore, we meet upon common ground.

As a matter of fact the only difference of opinion centres around the question as to whether the iliohypogastric nerve sends any important nerve supply into the internal oblique within the zone of our operation. Most anatomists are agreed upon the point that the nerve in the posterior part of its course sends motor fibres into the lower part of this muscle. Dowd also infers as much when he makes the statement that "fibres are given off from these nerves as they course *through* (italics mine) the muscle. These fibres can be seen if careful dissection is made." Our operative field, however, is at a considerable distance from the point where the nerve pierces the muscles, and in our operative field the nerve merely lies on top of the internal oblique muscle, covered by a delicate fascia.

One further statement of Dowd regarding the more minute anatomy of the nerve requires at least a passing comment. It is the following: "Serial microscopic sections have also been made and they show the small fibres of the nerve between the muscle bundles and the main trunk." It appears to me that this statement is somewhat ambiguous, and for the following reasons. First, that to be of some value as an argument, that these are motor nerves, these histological data are altogether inconclusive, on the contrary it would be necessary to show by serial sections that these nerves are directly traceable into the main trunk, second, because no proof is brought forward, nor for that matter can be brought forward, as to whether these nerve fibres are motor or sensory.

## (2) PHYSIOLOGY

To the uninitiated it doubtlessly appears that the establishment of the fact as to whether a given nerve is sensory or motor is a very simple matter. All that appears to be necessary would be to apply a faradic current, if the muscle attached to the nerve contracts, it is a motor nerve, if it does not contract, it is a sensory nerve. As a matter of fact, this is one of the proofs brought forward by Dowd, in order to prove his contention, and I confess, that for awhile I was under a similar impression. I determined, nevertheless, to test this matter for myself. I therefore made the following experiments in a

number of consecutive cases Well towards the outer part of the operative field the iliohypogastric nerve was carefully dissected free from the underlying internal oblique muscle, for a distance of one to two centimetres, and a piece of sterilized rubber tissue drawn underneath it The function of the nerve was then tested, first with a mild, then with a medium, and finally with a strong faradic current, by means of a specially constructed sterilizable electrode In my first two cases no contraction whatsoever was obtained, whereupon I hastily jumped to the conclusion that the experiment was an absolute proof of my contention, that the iliohypogastric nerve was a sensory nerve In the next case, however, I did obtain contractions, and subsequently the results were either positive or negative without apparent reason

In the next series of experiments I exposed and liberated the nerve in a similar manner, and then deliberately divided it, both ends were then stimulated in the same manner with a faradic current of varying intensity Again my results were indecisive Finally I reached the conclusion, that the results depended mostly upon the moisture within or upon the surface of the nerve, and that the current was conducted upon the moisture Even this had to be tested out, and I did so by sending a faradic current into the muscle on a piece of dry and a wet silk thread I found that contractions were obtained only when the latter was used I have related these experiments not to prove my preconceived notions or to disprove the contentions of Dowd, but merely to show that these and similar experiments are absolutely unconvincing

I next determined to test the matter out by deliberate division of the nerve in an actual operation, in order to determine the end results All these cases were followed out long enough to enable me to state definitely that no harm resulted therefrom, and that a perfect-end-result is maintained This experiment may also serve to answer the contention, that very important trophic nerve fibres are given off from the iliohypogastric nerve to the internal oblique Incidentally I may mention that the entire subject of the importance of trophic nerve fibres to muscles is so involved that only speculative views are current

To recapitulate, the component elements of the entire problem are the following

- 1 It is conceded that at its origin the iliohypogastric nerve is a mixed nerve
- 2 It is conceded that its termination in the skin is purely sensory
- 3 It is conceded that in its posterior part it supplies motor filaments to the internal oblique and transversalis muscles
- 4 Granting these three propositions, it follows also that in some part of its course the iliohypogastric nerve ceases to be a mixed nerve and becomes purely sensory The question, therefore, is where is that

point, and, more particularly, is that point proximal or distal to its exposure in our operation for inguinal hernia?

I have already pointed out the fallacies of the methods hitherto pursued, especially in my hands. Therefore, after consulting with Prof Lee, of the Department of Physiology, and with Prof Tilney, of the Department of Neurology, of the College of Physicians and Surgeons, the conclusion was reached, that the only way to prove or disprove my contention, was by a rather complicated animal experiment.

A little reflection will show that the only way to prove the problem experimentally was to cause a degenerative process in the peripheral distribution of the nerve, and the simplest method by which to attain such a degeneration is by a section of the nerve.

Further reflection will also show that in order to be of value the nerve section must be made in such a manner that either the sensory or the motor part of the nerve will degenerate, but always to the complete exclusion of the other. A study of Fig 1, illustrating diagrammatically a peripheral nerve with the corresponding segment of the spinal cord, shows that a section of the nerve can be made at three different points.

1 A section made at 1 will be of no value, for the reason that the entire nerve distal to the section, namely, both motor and sensory, will degenerate, because both portions have been separated from their centres, which for the sensory fibres is in the ganglion upon the sensory root, and for the motor fibres in the gray matter of the anterior horn of the spinal cord. It is evident, therefore, that our section must be made upon a part of the nerve before its sensory and motor portions have become united.

2 Similarly it would be absolutely of no value to divide the posterior nerve roots at 2 (Fig 1) (a comparatively easy operation), because after such a section none of the peripheral nerve would degenerate, for the reason that neither the motor nor the sensory part of the nerve has been separated from its centres.

3 There remains, therefore, only the third possibility, namely, to make a section of the anterior nerve roots at their emergence from the anterior horns, as is indicated at 3 of Fig 1.

The rationale of the operation is the following:

(a) Such a section would cause a degeneration of all the peripheral part of the motor nerve, because it has been separated from its centre in the gray matter of the anterior horn of the spinal cord.

(b) Such a section would cause no degeneration in the peripheral sensory part of the nerve, because that part of the nerve is still in connection with its centre in the ganglion upon its root.

(So delicate is this test that even an accidental injury of the posterior nerve root in the course of the operation would have no deleterious effect upon the experiment, all that such an injury could do would be to cause a degeneration of the corresponding nerve fibres in the spinal cord.)

(c) Assuming now that the animal survived the operation for a period of time sufficiently long to have caused a degeneration of the nerve, it will be necessary to examine different portions of the nerve for degenerative changes. From the nature of the experiment it also follows, that all that portion of the nerve which is degenerated must be motor, and whatever is not degenerated must be sensory.

(d) In order to prove our contention beyond any doubt, it is absolutely important that every one of the anterior roots which enter into the formation of the iliohypogastric nerve be divided, because it is also perfectly possible that some motor fibres might have escaped degeneration in the peripheral part of the nerve, and so might be mistaken for sensory nerve fibres. Even in the human being the forma-

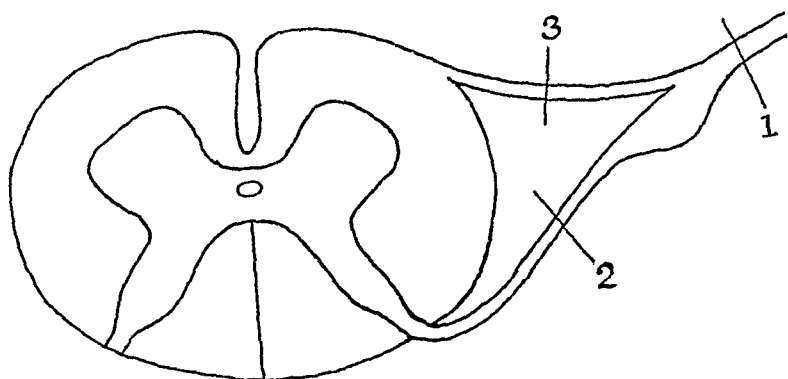


FIG 1

tion of the lumbar plexus is not absolutely uniform, as already stated, however, the consensus of opinion is, that the iliohypogastric nerve is a branch of the first lumbar nerve, and receives also fibres from the last intercostal, so that all that would be necessary in the human being would be to divide these two roots. In the dog, however, there appear to be so many variations, that to be absolutely certain one would also have to divide at least the two adjoining nerve roots, namely the eleventh dorsal and second lumbar, and to be absolutely certain it was decided to divide at least five roots. This, of course, increases the risk of the operation and also the dangers of infection, and it is particularly on this account that our absolutely successful experiments are limited to two.

Five experiments were performed. The results, as already stated, were satisfactory in only two. It was found that a very long exposure of the cord was required to divide five roots in the region in question, and that one was not always successful in the division of the anterior roots. So much of the bony support of the spinal column was necessarily removed, that some bowing of the back was unavoidable. The

operation partakes necessarily of a very major character. These remarks will serve as an explanation for the three unsatisfactory results. One dog died two days after operation. In another there was a wide separation of the wound, exposure of cord, and incomplete division of the nerve roots. In a third case the roots were incorrectly selected and incompletely divided. It should be clearly understood, however, that in none of these unsatisfactory experiments did examination of the iliohypogastric nerve in the inguinal region show any trace of degeneration. It should be also stated, that in our opinion, a single satisfactory experiment in degeneration after root section is sufficient to establish the point in question, when as many as five roots (two above and two below the main, if not the entire source of the iliohypogastric nerve) are divided.

The successful experiments are the following

*Experiment 1*—Dog 88, good sized male. Operation, January 5, 1916. Dog in prone posture. Median incision over the lower dorsal and upper lumbar spine. Spinous processes of the eleventh and twelfth thoracic, first, second, and third lumbar vertebræ isolated by incising and stripping back the musculature on both sides. These spines and their laminae were removed beyond the articular junctions. A long and wide exposure of the dura was thereby obtained. Tension sutures were placed through the dura, and the latter incised between them. Dura slit up and down with a grooved director. Some cerebrospinal fluid escaped. It was planned to divide the left anterior roots, therefore the left dentate ligaments were divided in order to mobilize the cord. The anterior roots were now divided by slipping a fine scissors under the posterior roots. Each division was followed by muscular contraction and rather free bleeding. The roots divided were the eleventh and twelfth dorsal, first, second and third lumbar. As the dura could not be sutured without constricting the cord, a strip of aponeurosis from over the erector spinæ, 2 cm wide and of appropriate length, was sutured into the dural gap with fine silk. Layer suture of the muscles, aponeurosis of the erector spinæ and skin. Cotton collodion dressing.

*Post-operative Course*—Primary union. For several days both hind legs were weak and dragged on walking. Reflexes were normal, however, and bladder and rectal control appeared undisturbed. Normal power in legs returned about eight days after operation. Animal sacrificed with chloroform, January 24, nineteen days after operation.

*Post-mortem Examination*—Firm union of tissues. No evidence of infection. The cord is overspread by a dense layer of connective tissue, loosely attached to it. The dura is adherent to this layer only at the cut margins. Cerebrospinal fluid not encountered in the field of operation. No evidence of injury to the cord. The roots divided were again verified to be the eleventh and twelfth dorsal, the first, second, and third lumbar. The eleventh dorsal and second lumbar divisions did not completely separate the ensheathing connective tissue.

The iliohypogastric nerve was exposed throughout its entire course. (Right here we wish to mention, that in numerous dissections we have found that the peripheral course and distribution of the iliohypogastric nerve in the dog is exactly the same as in the human being.) No gross changes were seen. Sections were taken from various parts of the nerve and labeled (A) From the upper



part of its course, (B) from the middle part of its course, (C) from that part of its course which lies in the inguinal region

*Microscopic Examination*—Surgical Pathology No 3791 A, B, and C Marchi's stain Many slides made from each section, cut longitudinally

Section A (Fig 2) shows moderate amount of segmentation of the fibres and granular deposition of fat in approximately one-half of the longitudinally sectioned nerve The other half shows no trace of degeneration

Section B (Fig 3) shows the same picture as A, with degeneration to the same extent and limitation

Section C (Fig 4) shows absolutely no trace of degeneration, normally staining nerve

*Experiment 2*—Dog 78, female, fair size Operation, December 22, 1915, same procedure as in previous experiment There was considerable oozing from the divided musculature, controlled by pressure The posterior spinal vein was slightly injured in opening the dura, but a ligature was not required The left anterior eleventh and twelfth dorsal and first, second, and third lumbar roots were divided (The corrected root division is given in the post-mortem examination) The dura was not sutured, and fascia was not implanted into the defect Layer suture of the wound

*Post-operative Course*—Slight separation and infection of the upper part of the wound No evidence of cord injury Animal sacrificed with chloroform on January 7, 1916, sixteen days after operation

*Post-mortem Examination*—Thin inflammatory membrane over the upper part of the cord exposed at operation

The left anterior roots were found completely divided They were the tenth, eleventh, and twelfth dorsal, and first and second lumbar No gross changes were seen in the left iliohypogastric nerve

Sections were taken as in the previous experiment and similarly labeled A, B and C

*Microscopic Examination*—Surgical Pathology No 3813, A, B, and C Marchi's stain Sections cut longitudinally

Section A (Fig 5) In different slides moderate to severe segmentation and fragmentation of the nerve fibres into thick zones, with a mass of non-degenerated fibres in the middle The total diameter of the degenerated portion approximately equalled that of the non-degenerated mass of nerve bundles

Section B (Fig 6) Approximately one-half of the nerve shows moderately advanced degeneration

Section C (Fig 7) No evidence of degeneration, normally staining nerve

These two successful experiments therefore prove the following

1 The posterior part of the iliohypogastric nerve is a mixed nerve, *i e*, both motor and sensory

2 That part of the iliohypogastric nerve which is exposed in the conventional operation for the radical cure of inguinal hernia is purely sensory

# RÉSUMÉ

1 That part of the iliohypogastric nerve which is exposed in the conventional hernia operation is to be preserved, because there is no necessity for dividing it, and also because its complete division will be followed by a temporary anæsthesia of the hypogastric region After

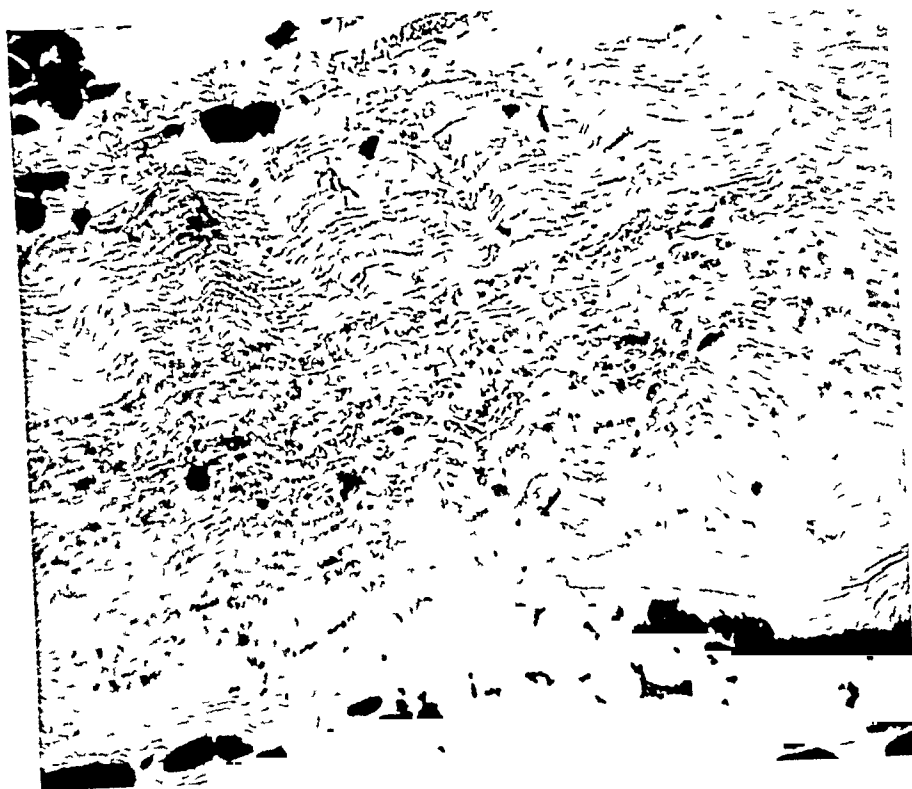


FIG 2



FIG 3

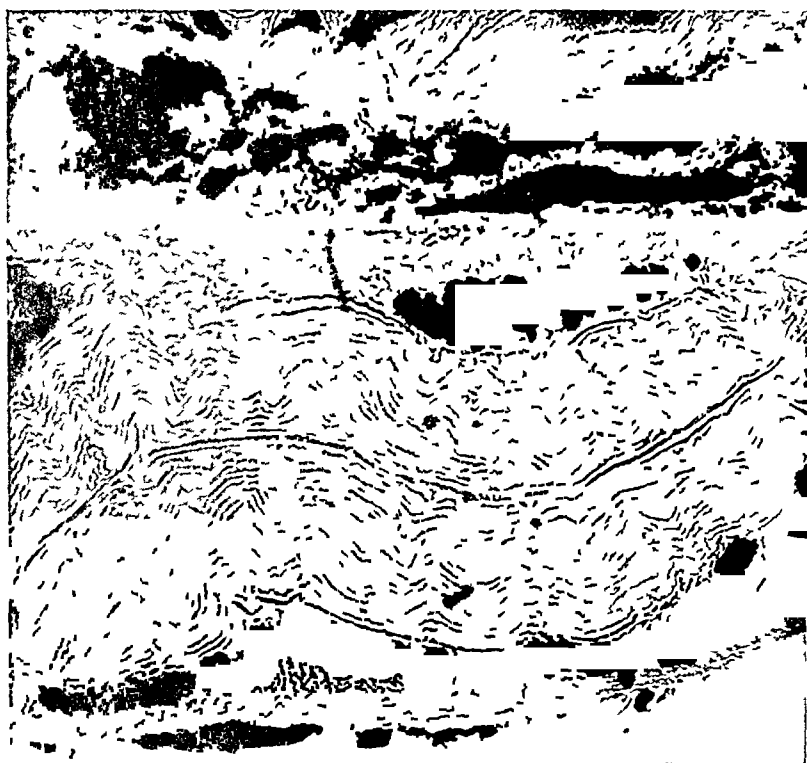


FIG 4

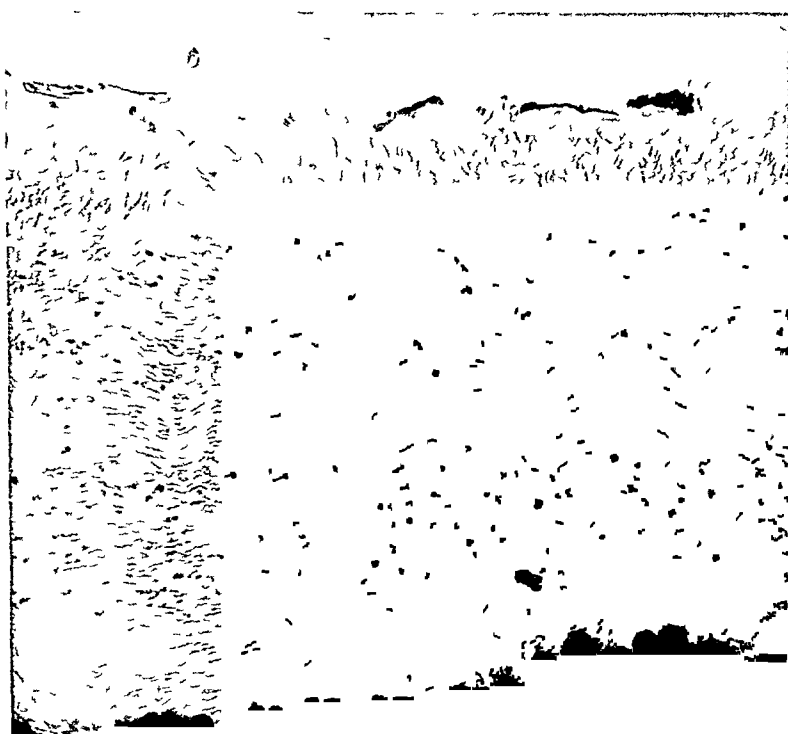


FIG 5



FIG 6

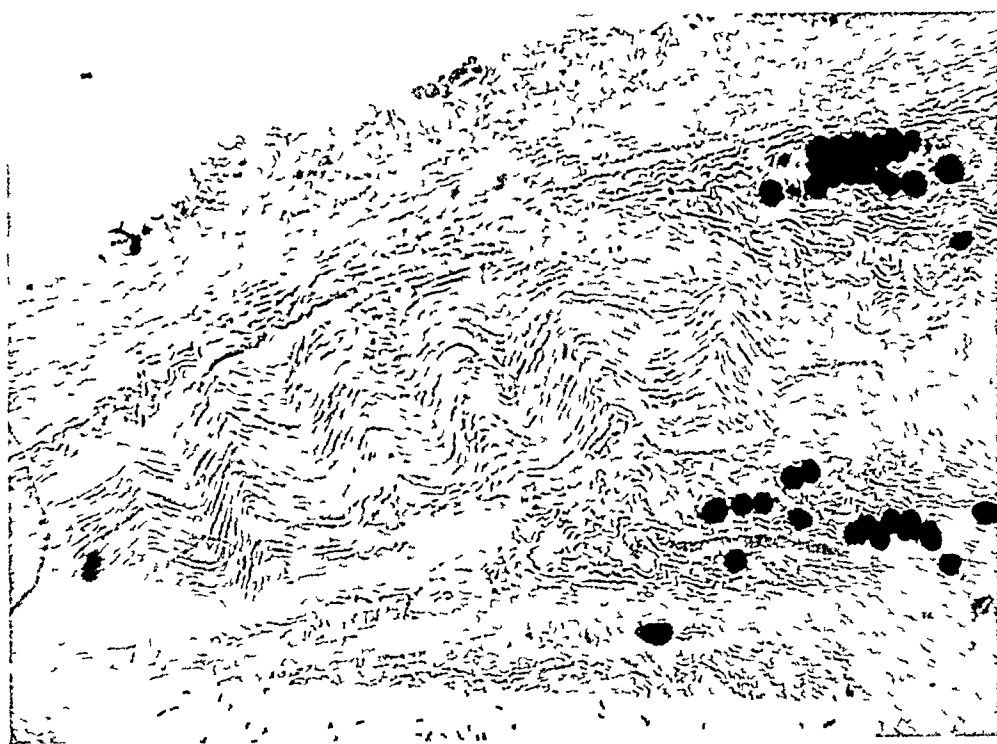


FIG 7



## ILIOHYPOGASTRIC NERVE AND INGUINAL HERNIA

a while regeneration of the nerve occurs and the anæsthesia disappears

2 The nerve should be protected from a careless inclusion in the suture line. Such a careless inclusion is likely to be followed by a neuralgic pain.

3 A careless division of the nerve is not followed by a local paralysis of the internal oblique muscle and therefore has no bearing upon the radical cure.

# SOME OF THE PROBLEMS OF PLASTIC SURGERY †

BY JOHN STAIGE DAVIS, M D

OF BALTIMORE, MD

By plastic and reconstructive surgery I mean that branch of surgery which deals with the repair of defects and malformations, either congenital or acquired, and with the restoration of function and improvement of appearance. This is accomplished chiefly by the transfer of tissue, either from the immediate neighborhood or from some distant part. The deformities dealt with in plastic surgery for the most part involve the skin or adjacent soft parts, rather than the bones and joints, the ligaments or tendons. The treatment of large denuded surfaces, requiring skin grafting, and of intractable wounds, should also come under the care of the plastic surgeon.

In reconstructive surgery on the jaws and palate the plastic surgeon should have the cooperation of a skilled dental surgeon. The plastic surgeon, with his special knowledge of tissue transplantation, can be of great use to the general surgeon and to the orthopedist in repairing the defects left by certain necessarily mutilating operations. This also applies to the gynecologist and genito-urinary surgeon, when called on to perform more extensive transplantations than they are accustomed to undertake.

My experience has been that we seldom, if ever, find two plastic cases exactly alike, and thus no "cut and dried" methods can be employed. Each case should be carefully studied and the various methods of repair considered from every standpoint. This endless variety in itself brings a certain fascination to the operative treatment, and to the after-care of these patients. Keen surgical judgment is often necessary to determine what should be done, whether or not a plastic procedure should be finished at one operation, how far to go in the initial operation, and when to follow with the secondary procedures. The results in certain groups of cases are very slow, and in these the process is one of gradual building up. In such cases the entire series of operations should be planned with regard to the ultimate result, and not to the immediate relief of the condition. The post-operative treatment and dressings should be done by the surgeon himself, or directly under his eye, as successful results in a great measure depend on skilful and judicious after-treatment.

The simpler the operation the more likely it is to succeed, and this is especially exemplified in the operations for the relief of

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\* Read before the Philadelphia Academy of Surgery, March 5, 1917

harelip It is wise to make haste slowly in plastic surgery, and to underdo, rather than overdo Thorough familiarity with the free transplantation of skin, fat, fascia, bone and cartilage is essential, as all of these tissues are constantly utilized in reconstructive work The principles of tissue shifting, and of the use of pedunculated flaps, must be understood, and also the possibilities of combinations with the above mentioned free transplants

A few words concerning these transplantations may be of interest

*Transplantation of Skin*—The use of skin grafts is absolutely essential in plastic surgery There is seldom a case of any magnitude in reconstructive work in which some form of skin grafting is not used at one time or another during the process

Skin grafts may be divided in general into *thin grafts* where only the superficial layers are utilized, as obtained by the methods of Reverdin and of Ollier-Thiersch; and *thick grafts* where the whole thickness or nearly the whole thickness of the skin is used This latter division includes *small deep grafts*, secured in much the same manner as Reverdin grafts, but often including the whole thickness of the skin, also the so-called Wolfe-Krause grafts, which include the full thickness of the skin

Grafts may be further classified into auto-grafts, where the graft is obtained from the same individual, *iso-grafts* where the graft is obtained from another individual of the same species, and *zoo-grafts* where the graft is obtained from a lower species

I will not go into the technic of obtaining these grafts, but will only say that both thin and thick grafts may be successfully transplanted on healthy granulating surfaces, as well as on fresh wounds

*Iso-Grafts*—There is much difference of opinion as to the advisability of utilizing iso-grafts, and many surgeons insist that only auto-grafts should be used Of course, auto-grafts are more likely to succeed, but I feel convinced, when it is not possible to utilize auto-grafts, that iso-grafts are well worth trying, and that very good lasting results may be secured if the grafts are obtained and transplanted with the proper technic The success or failure of iso-grafts may be dependent on the similarity of blood groups of the host and donor, and a subsequent report will be made on this point

*Zoo-Grafts*—Many successes have been reported following the use of zoo-grafts from various animals My own experience is that these grafts take readily and receive their blood supply as promptly as ordinary grafts They also have the power of stimulating wound as do other grafts However, in every case which has been under my observation these grafts, after doing well and often when the wound is entirely healed, will suddenly with no apparent cause begin to melt away, and will soon disappear



*Transplantation of Fat*—Free fat grafts are used principally for filling in depressions. They can be successfully transplanted and enough of the tissue will survive to accomplish the desired purpose. Some surgeons prefer small bits and others pieces of considerable size and thickness. This tissue must be most carefully handled to prevent bruising. The defect into which it is placed must be perfectly dry and asepsis must be maintained. Fat is also used in plastic surgery to prevent adhesions around tendons and nerves. Often a pedunculated flap of skin with a very large mass of fat is transplanted, and in this way better circulation is assured.

Subcutaneous fat is the usual source of supply, and this is ordinarily abundant on the abdominal wall, or on the thigh. Omental fat has been used successfully, but one would hardly feel justified in opening the abdomen for the sole purpose of obtaining fat.

*Transplantation of Fascia*—Fascia is used in plastic surgery for a number of purposes. It is valuable for reinforcing weakened or defective tissues. New tendons may be constructed of it. It may be used for the relief of ptosis. It may be used either alone or with fat in joints. Fascia lata is the favorite source of supply, but the deep fascia obtained almost anywhere is very satisfactory.

*Transplantation of Bone and Cartilage*—Bone and cartilage are normally the supporting framework for the soft parts, and both are used for this purpose in reconstructive surgery. When bone is chosen for the supporting substance, it is advisable to leave the periosteum intact. It must be borne in mind that free grafts of bone, either with or without periosteum, when transplanted into soft parts will eventually absorb. I have found experimentally and clinically that a bone graft in contact with bone at one end and extending into the soft parts, without special function, will become thin and eventually lose its power to act as a support. However, if the bone transplant is placed in contact with living bone at each end, it will become a permanent supporting framework. Whether the graft lives or whether it is replaced is still a matter of dispute, the pros and cons of which we will not consider here.

Cartilage, on the other hand, is an ideal supporting substance for transplantation, and will live and not shrink when transplanted free, either with or without its perichondrium, into soft parts. It will also live when in contact with bone at one or both ends. Rib cartilage is the usual source of supply. Cartilage is flexible and thus less liable to subsequent fracture, it can be easily cut and shaped into any desired form, it is no more difficult to obtain than bone, and a large supply is always available. Any one of these advantages, it seems to me, would suggest the use of cartilage rather than of bone for the supporting material in transplantation for the correction of saddle nose, the filling out of sunken areas on the face, and also for the framework in rhinoplastic operations.

*Mucous Membrane Transplantation* —Free grafts of mucous membrane are of little value either when transplanted to the eyelids or into the mouth. Mucous membrane offers little if any advantage in these situations over very thin Thiersch grafts, and the results are usually unsatisfactory. Pedunculated flaps of mucous membrane in the mouth are often successful, and if mucous membrane is not available, pedunculated skin flaps can be used with equal success, and with very good permanent results.

*Subcutaneous Hydriocarbon Prosthesis* —The injection of paraffin has been advocated by a number of men, and is principally used for correcting certain deformities about the face. This can be done with a little practice by anyone who is able to purchase the equipment, and gives immediate results which are, at first, very satisfactory to the patient. This method is the sheet-anchor of the "quack" facial specialist. However, paraffin often shifts its position gradually, and trickles down the tissue planes, or, perhaps, the infiltrated tissues may thicken and cause deformities which are much worse than the original defect. For a number of years I have felt that the injection of paraffin, and similar substances, is bad surgery, and have spent much time in trying to remove the paraffin injected by others, and in correcting the deformities caused by these injections.

*Definition of Terms* —By a *flap* we mean a mass of tissue attached at some portion of its circumference by a pedicle, which can be shifted at once or later as far as the pedicle will allow.

By a *graft* we mean a mass of tissue which is cut free to be transplanted wherever necessary.

A surface defect may be closed in one of four ways.

First, by skin grafting.

Second, by sliding the edges together and suturing, called the French method. In those instances where there is tension the skin may be mobilized to a very great extent by undercutting, and in this way large areas of skin may be shifted in without impairing its vitality. If direct union is impossible in a wound, even after undercutting, then lateral liberating incisions may be made, either on one or both sides, and the edges closed, leaving one or two smaller defects in place of a large one.

Third, by pedunculated flaps from tissue in the immediate neighborhood, called the Indian method. In some instances healthy flaps from adjacent tissue are impossible to get, especially in finger contractures, or where a defect is situated in the midst of scar tissue.

Fourth, by pedunculated flaps from distant parts, called the Italian method. This may be done either by a single or double transfer. It is usually easy to secure sufficient tissue by using flaps from distant parts, but the constrained position necessary in order to utilize these flaps is exceedingly irksome to the patient, and many are unwilling to endure the discomfort.

In all sorts of plastic operations it is advantageous that the patient should be in the best possible physical condition, and no plastic operation should be undertaken on those with active local disease still present. Asepsis rather than antiseptis should be maintained throughout the operation, and during convalescence. The tissues should be treated with the greatest consideration. Sharp cutting instruments must be used to avoid unnecessary injury to the tissues. The flaps should be handled with special forceps or small sharp hooks. The area into which the flap or graft is to be transferred should be perfectly dry, and all hemorrhage checked, as many failures are due to a blood clot collecting beneath the transplant, which prevents the early formation of a new blood supply. An accurate estimate of immediate and subsequent tissue shrinkage must be planned for. Accurate apposition is desirable as prompt healing minimizes scar tissue.

One of the most important points in plastic surgery when tissue of any kind is transferred, is that there be no tension either on flaps or on free grafts. Never leave a suture in place which blanches the transplanted tissues, as it is better to gain only a portion of the necessary distance than to jeopardize the whole flap. The use of pedunculated flaps is especially valuable when a pad of fat is required in addition to the whole thickness of the skin. The shape of the flap must correspond fairly accurately to the defect which it is to cover. Thin flaps are so pliable that they can easily be adjusted to fit a defect of almost any shape, but, especially in rhinoplastic operations, it is advisable to outline the flap from a carefully calculated pattern.

The skin of pedunculated flaps, as well as of whole thickness grafts, must be chosen with some regard to the area into which it is to be placed. The flap should be cut at least one-third larger than the area it is to fill, and this equally applies to grafts of whole thickness skin. The shrinkage of both flap and graft is in the direction of the elastic fibres. Normal skin is necessary for a successful flap, as any scar on the edge of a flap will usually slough, and a scar running across a flap will completely cut off the circulation beyond it. Always excise the scar if possible along the edges to be sutured, as the healing will be much more satisfactory.

The pedicle should be as broad as possible. Always aim to have the pedicle very close to the loss of substance. The long axis of the pedicle should be in the same direction as the axis of the flap in the new situation. The pedicle of a flap should be in the same line as the area to be filled. The elasticity of the skin will allow a curved flap to assume a straight position without difficulty.

As a general rule the flap should not be longer than two and a half or three times the width of the pedicle. The pedicle should not be twisted enough to interfere with the circulation of the flap. The flap should be made of the skin and subcutaneous fat, and in some large wounds the deep fascia may be included. The amount of fat should

be somewhat thicker than is actually necessary to fill the defect, as the excess is taken care of by subsequent shrinkage. It is unwise to include muscle with the skin and fat flap to be shifted. The shifting of muscle, etc., should be done separately. A flap may be cut much thinner if its pedicle contains a main artery, and it is of advantage to have the artery. However, a main artery is not essential if the flap is thick and includes enough smaller vessels for its proper nutrition.

Twisting or too much tension on a pedicle may cause the shutting off of circulation and subsequent death of the flap. There is sometimes death of a pedunculated flap which has an excellent blood supply due to the lack of drainage from the flap. In other words, the flap is choked by the blood entering it and being unable to get out promptly. This is especially to be feared if the pedicle contains a main artery. This danger is overcome by scarifying the flap to allow surface drainage until the proper vessel drainage is established. Scarifying for drainage is not necessary in whole thickness free grafts. Perforation of the grafts is essential, however, to allow the escape of blood or serum which may collect beneath the graft.

When there is doubt about the circulation in a long narrow flap, it is advisable to separate it from the deeper structures but to leave it attached at each end. Keep it separated from its bed by rubber protective, or by covering the bed with Thiersch grafts, and then after two or three weeks cut one pedicle and transfer the flap. As a rule it is best to wait from 10 days to two weeks before amputating the pedicle of a flap. This may be done by notching on each side of the base and thus gradually cutting off the circulation of the pedicle or the amputation may be done at one time, and after the pedicle is cut through it should at once be fitted into its proper position, as in this way a better result can be obtained with little, if any, loss of the tissue in the pedicle. The area from which the pedunculated flap is taken may be closed with sutures if the skin is lax, or after undercutting and sliding. If closure is not possible on account of the size of the area, then the defect may be covered with skin grafts, preferably of the Thiersch variety. Immobilization of the part with plaster, crinolin, or splint is essential, and the dressings next to the transplanted tissue should be soft and very carefully applied.

Flaps of normal tissue are often successfully shifted into the midst of scar tissue, but the circulation of these flaps should be especially good. A graft of whole thickness skin may also be placed successfully in the midst of movable scar tissue, and accomplish its purpose. The result in these cases being that the graft is more stable than the tissue which surrounds it, and it also follows that the scar becomes more resistant as the tension is relieved.

On a part completely covered with scar, as is often seen on the face, much can be done by the gradual shifting of the scar tissue itself, but this must be done very slowly, and with the greatest care, sometimes

only a fraction of an inch being gained at one operation. It is a waste of time to attempt to shift pedunculated flaps of scar tissue.

In plastic work I prefer to use small cervical needles for the deep sutures when they are necessary, and catgut for the suture material. For the skin I find the corneal needle satisfactory, and use horse-hair, very fine silk, silkworm gut, or silver wire, depending on the indications. In cleft palate work I find that silkworm gut and horse-hair for the hard and soft palates and fine silk for the uvula are most satisfactory. Special small curved needles are used for this work. Very fine catgut should be used for ligatures. It is rare in plastic surgery that we encounter a deformity which cannot be helped by logical surgical methods. At best we can only accomplish a certain amount, trusting in nature to complete our work.

# BONE AUTOGENOUS GRAFT IN THE TREATMENT OF FRACTURE OF THE GREATER TUBEROSITY OF THE HUMERUS

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FRACTURE of the greater tuberosity of the humerus is not such an infrequent occurrence as some might suppose, this has been demonstrated by the more frequent use of the X-ray in examining a class of injuries that would at first glance be treated as a severe contusion of the shoulder. While the majority of these injuries are due to a direct violence, there is a certain percentage that are due to a forcible contraction of the muscles. In cases where there is some doubt as to the diagnosis, a careful differentiation should be made from subacromial bursitis, since these two conditions present many symptoms in common. However, in the case of fracture, a history of violence or the use of the X-ray would make clear the diagnosis at once.

In presenting himself for treatment the patient will usually give the following symptoms. Inability to abduct the arm, movements backward and forward slow and painful. Frequently there is crepitus elicited by these movements, though by no means is this always the case.

It may be well to review briefly the anatomy of the parts concerned in these cases, thus making clear the reasons for the symptoms presented. It will be recalled that the supraspinatus, infraspinatus and teres minor are all attached to the greater tuberosity of the humerus, the action of the first being abduction and that of the last two being external rotation. While the deltoid is a powerful abductor of the arm, the use of this muscle would be attended with great pain in the cases under consideration, owing to the trauma.

As to the question of treatment—before the use of the X-ray these cases were treated as a severe contusion, and later on have furnished a large percentage of chronic dislocation of the shoulder-joint. Left to itself, in cases where there is complete separation, the muscles atrophy, the bone is drawn up under the deltoid, and there is inevitably a partial loss of function of the shoulder-joint. This is worthy of serious consideration when one recalls the manifold motions of this joint, during nearly every moment of activity.

Three methods have been proposed to remedy this injury<sup>1</sup>. (1) Resection, (2) suture, (3) immobilization. The first, in my

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<sup>1</sup>Des fractures par arrachement de grosse tuberosité de humérus, par Paul Forget. These pour le Doctorat en Méd., Faculté de Paris

opinion, can be dismissed as not being worthy of serious consideration. The second method, if it could be carried out satisfactorily, leaves nothing to be desired. Unfortunately, however, this has not always been easy to attain. The suture material used, whether it be kangaroo tendon or chromicized catgut, has not always held the fragments in place, and silver wire when used has been known to cause future trouble. The third method mentioned will yield a good result in some cases—those in which there is not a complete displacement of the bone and in which external rotation and abduction will bring the parts in complete coaptation. All such cases should be treated by this method.

In 1903, W. W. Keen<sup>2</sup> reported a case of fracture of the greater tuberosity in which the fragment was drawn up between the head of the humerus and spine of the scapula. The fragment could not be brought into its normal position by any kind of position or dressing, it was replaced through an open incision, and held there by means of two wire nails, 7.5 cm in length and 2 mm in diameter. The result was a complete restoration of normal function. It is believed that the method of using bone grafts in these cases will prove entirely satisfactory in injuries in which there is complete detachment of the lesser fragment. The parts can be exposed readily with very little injury to muscle or nerve and the fragment brought into apposition and so maintained, the grafts will favor a more ready union, and it would seem that there should be a complete restoration of good function. It may not prove uninteresting to report a case in which this method was used which came within a recent experience of the writer.

Private L, 122nd Company, Coast Artillery Corps, aged twenty-eight, years of service six and seven-twelfths, enlisted first time June 5, 1905. Previous history negative. Present illness. On morning of December 11, 1915, had started up concrete steps at the rear entrance to Barracks at Fort Hamilton, New York, when he slipped on the ice covering the steps and fell forward towards his left side. There was an iron railing on the right, and the soldier made an ineffectual attempt to grasp it with his left hand, but his hold slipped, the railing being covered with ice, and he fell heavily forward and upward, striking the left shoulder against the edge of concrete step. While lying in this position he made an attempt to grasp the railing with left hand when severe pain was elicited in the shoulder. Upon admission to hospital an examination was

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<sup>2</sup> Fracture of the Greater Tuberosity of the Humerus with Dislocation of the Humerus into the Axilla. Immediate Reduction of Dislocation on Seventh Day, Nailing of Fragment of Tuberosity in Place. *ANN OF SURGERY*, vol. XXXVII, May, 1903.

## BONE GRAFT IN FRACTURE OF HUMERUS

made immediately by Captain John R Bosley, Medical Corps, and there was found to be a loss of power of abduction, forward and backward motion slight, attended with considerable pain and a sort of clicking or crepitant sensation experienced by the patient. An X-ray picture made at the time showed a fracture of the greater tuberosity with complete separation (Fig 1). Major Joseph H Ford, Medical Corps, United States Army, Surgeon of the Coast Defence District, examined the case, rather favored the idea of operative interference, and it was due to his courtesy that the soldier was sent across to me at Fort Wadsworth with that end in view.

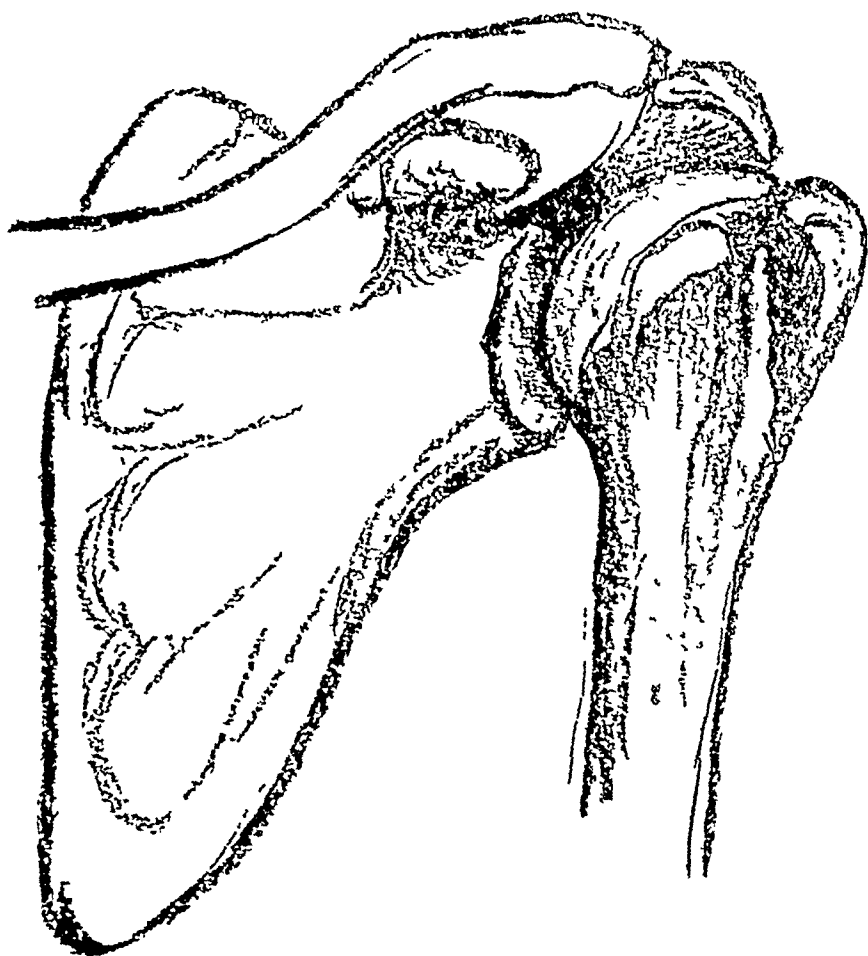


FIG 1 —Diagrammatic sketch showing relative position of fragment found at operation

*Operation* —On the eighth day following accident, the fracture was exposed through a long incision extending downward from the inner border of the acromion process and by separating the fibres of the deltoid by blunt dissection. The fracture was found to extend forward to the groove for the long head of the biceps, the anterior border of the detached fragment was elevated 5 cm and the posterior about one-half that distance. By means of abducting the arm and rotating it posteriorly, and grasping the muscles at their attachment to the tuberosity with tissue forceps, the detached portion was gradually brought into place, and while held firmly in this position



holes were drilled 4 cm in length and 4 mm in diameter, and about  $2\frac{1}{2}$  cm apart. The wound was now packed with hot compresses while a fragment of bone was removed from the crest of the tibia 4 cm in length and 1 cm in thickness at its widest portion. The fragment was now split longitudinally into two equal pieces and the angles of these were rounded. After again replacing the tuberosity these grafts were inserted into the holes previously prepared. This means was found effectual in holding the parts in good position (Fig 2). A rent in the capsule was repaired with chromic catgut, the deltoid brought together with a continuous plain catgut and the skin with a continuous silk suture. The arm was placed in a Velpeau bandage, which during the first few weeks was re-enforced with plaster. At the end of four weeks all dressings were removed except a triangular sling for the forearm, and massage and passive motion begun. Active motion was begun a week later and finally the motion of extreme abduction was practised. Upon return to duty at the end of about two months, soldier could abduct arm completely, and there was general restoration of function.

It is believed that the method herein described should be considered the method of choice in all cases of this fracture in which there is complete detachment with the fragment drawn upward beneath the deltoid.

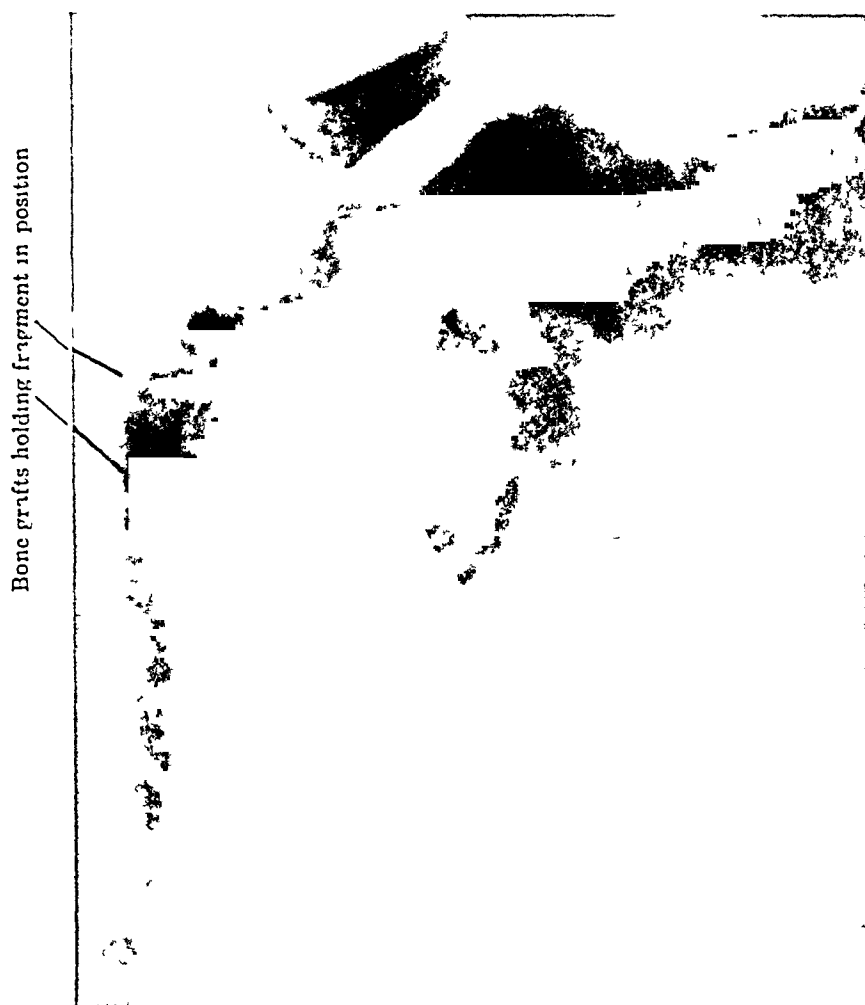


FIG 2 —X-ray photograph taken five days after operation, showing readjustment of fragment



# TRANSACTIONS

## OF THE

# PHILADELPHIA ACADEMY OF SURGERY

*Stated Meeting, held March 5, 1917*

The President, DR CHARLES H. FRAZIER, in the Chair

### X-RAY TREATMENT OF CARBUNCLE OF FACE

DR GEORGE G ROSS presented a woman, sixty-two years of age, who was admitted to the Stetson Hospital on December 23, 1916 Her history showed that on November 23, 1916, she had first noticed a "small pimple" in the right temporal region just anterior to the ear This grew very hard and painful, enlarged rapidly, and spread to the cheek and side of the neck The carbuncle was incised, but grew rapidly worse On admission the patient showed on the right side the face a hard, deeply congested swelling, containing numerous small openings from which a little pus oozed, showing slough beneath This swelling extended from just anterior to the ear around under the eye and down the neck to just above the clavicle, involving the whole side of the face and cheek over to the edge of the mouth and nose This is well shown in the accompanying photograph (Fig 1)

The patient's general condition was poor Her previous history of polyuria and pruritus suggested diabetes, and there was also a history of glycosuria Sugar was, however, not shown in the urine until January 4, 1917, and then in small quantity ( 277 per cent ) Later it was more abundant and has been in evidence since her discharge from the hospital The temperature on admission was 101 degrees and never ran above this, being practically normal after the third week Pain was not marked and the carbuncle was markedly insensitive to handling The process was exactly such a slow sloughing with sub-acute infection as is often seen in diabetic conditions

The patient was placed upon liquid diet with milk and eggs freely given Flaxseed poultices were applied and continued until January 18, 1917 Local treatment was from the first confined to cleansing, removal of detritus, and touching the openings with tincture of iodine The first X-ray treatment was given on December 27, 1916, and three subsequent ones on January 1, January 5, and January 18, 1917, respectively Each one was of ten minutes' duration and given without

filtration A five milliampere current backed up against a  $4\frac{1}{2}$ -inch spark After each treatment there was a marked reaction Improvement was noted after the first treatment and each subsequent one (Fig 2) The inflammatory swelling began to subside and the carbuncle literally dried up The pictures show this better than it can be described The local process made an uninterrupted recovery In the second week the swelling below the angle of the jaw became so marked that it seemed that incision would be necessary, but improvement under the X-ray made this unnecessary The patient's general condition rapidly improved and she was able to be up on January 18, 1917 A troublesome diarrhoea and pains, probably phlebitic, in the lower extremities delayed her complete recovery

## GALL-STONE ILEUS

DR GEORGE G ROSS presented an elderly woman, who was admitted to hospital December 3, 1916, with the history that about twenty-four hours before admission she was seized with sudden cramp-like pain in central abdomen There was no radiation and it increased in intensity Nausea and vomiting started almost immediately and continued at very short intervals until admission At first the vomitus was yellowish, but later it became dark brown and of a fecal odor It was forcible in type Patient's bowels moved twice after the onset of sickness without any medical agents There were no cardiac, pulmonary or renal symptoms According to her statements she had always been in good health except for an attack of severe upper abdominal pain about one year ago, lasting for two or three days and accompanied with nausea and vomiting Has never been jaundiced Has never noticed clay-colored stools She has never been troubled with gastro-intestinal symptoms aside from the above, and occasional gaseous eructations Physical examination reveals an elderly white female, apparently very acutely ill Frequent vomiting of dark fluid material with intense fecal odor Pulse is good in volume and regular Heart and lungs negative to rapid examination Abdomen pendulous There is no point of special tenderness, but a general soreness There are no palpable masses Inguinal and femoral hernial orifices free

The abdomen was opened by a right rectus incision just below the level of the umbilicus Considerable free blood-stained fluid within the peritoneal cavity Peritoneum slightly injected Hernial orifices free In the pouch of Douglas was a loop of ileum, in the lumen of the most dependent portion of which was a mass about the size of a walnut Intestine slightly dilated above the obstruction Bowel incised over the mass which was expressed through the incision It appeared



FIG 1 —Carbuncle of cheek



FIG 2 —Carbuncle of face Condition after two applications of the X-ray



## PROBLEMS OF PLASTIC SURGERY

to be a gall-stone. The bowel was closed by fine catgut suture. Peritoneum stitched over the line of incision with linen thread. To palpation the gall-bladder was very much contracted and the lumen practically obliterated. There were old adhesions between the gall-bladder and bowel. The abdomen was closed without drainage.

Except for a moderate superficial infection her subsequent progress of recovery was uneventful and she was discharged at the end of five weeks.

The obstruction in this case was due to two conditions. First, the diminution of the lumen by the large stone, and second, to the sharp angulation of the gut caused by the weight of the stone.

## PROBLEMS OF PLASTIC SURGERY

DR JOHN STANGE DAVIS (of Baltimore) read, by invitation, a paper with the above title, for which see page 88.

DR JOHN B. ROBERTS said that of late years he had been more interested in what might be called cosmetic constructive and reconstructive surgery than in strategic and substitutive plastic surgery. The last two are often valuable in obtaining access to deeper organs and in supplying physiologic substitutes for structures put out of commission by operation or disease. Cosmetic surgery affords operative relief in congenital deformities and deformities due to loss of tissue. To illustrate some of the results he had brought a patient and a few photographs of other patients to give an idea of what he considered good plans of treatment. This boy, now eleven years old, had been under his care for successive operations since he was about five years old. He lost, by cicatricial contraction after deep burns, the use of his left thumb, which is shown by the photographs (Figs 3 and 4). In addition his left ear was deformed in its lower portion by being buried in cicatricial tissue close against the lower part of his skull. He had no chin, because the deep sloughing and scarring of the neck had drawn the lower jaw close to the front of the laryngeal region. His lower lip was attached to the mental region so that it was dragged outward allowing saliva to flow over. His mouth, therefore, could not be closed and he could not lift his head from his chest (Fig 5). The thumb, which was extended and abducted and attached to the front of the wrist by contraction, was by a succession of operations liberated by sliding tissue from the dorsal and palmar surfaces of the forearm into the gap left when the flexed wrist and the movable thumb were after incisions put in proper position. A portion of the gap was closed by a large flap obtained by attaching the hand and forearm to the abdomen for a couple of weeks. He now has a fairly movable thumb and a straight wrist (Fig 4). By sliding and transferring pedunculated



flaps from the sides of the neck, the head was liberated and a chin made. The everted lower lip shown in the original photograph was freed and replaced so that he could close the mouth, and a new external portion made to the lip by utilizing flaps from the outer portions of the upper lip and some of the flap taken from the anterior belly wall to fill in the space left when the thumb was liberated. Sliding flaps were used to make a new lobe to the ear. This was accomplished by using a folded flap with penetrating mattress sutures to form a lobe. The final result obtained is shown in Fig 7.

The method of transporting a flap from abdomen or thigh is shown in Fig 8, which shows a large piece of skin and superficial fascia removed from the thigh of a patient and attached to the left hand to be carried to the face to make the lower part of the nose, lost by syphilis. Figs 9 and 10 show how the ponderous nose due to rhinophyma or hypertrophic acne may be relieved. This man's nose was shaved down to a proper shape by a razor and a large Thiersch epithelial skin graft from the thigh was placed upon the end of the nose. The photograph was taken very shortly after the skin graft was placed in position. The cure was very satisfactory.

Figs 11 and 12 show the value of adipose tissue grafts to restore the contour of the cheek. The patient had had, since early manhood, a deeply attached furrow scar of the cheek, due to a kick by a horse. By splitting open the tissues, incising the scar tissue latterly beneath the skin and inserting a free flap of fatty tissue from the front of the abdomen, he was able to fill out the cheek as shown in the picture. This, it will be seen, was made a little over-full because shrinkage is sure to take place later. The second photograph was made about three weeks after the operation.

DR FRANCIS T STEWART said, in regard to æsthetic surgery, that one of the principles which should be emphasized is the taking of the tissue from the immediate neighborhood of the defect whenever that is possible. The secondary changes which take place in a graft taken from a distance sometimes make the repair as unsightly as the defect. The Italian method of transplantation was until recently the only method of bringing parts from a distance, but this has fallen into increasing disuse because of the employment of the free transplantations. In the correction of defects especially of the face which is the only part, at least in man, which can always be seen, tissue from the scalp can be used to advantage. Fortunately the hair follicles are preserved and the hair grows and covers up whatever irregularities the surgeon may not have had the skill or the opportunity to correct.

#### ACUTE PERFORATION OF GASTRIC AND DUODENAL ULCERS

DR EMORY G ALEXANDER read a paper with the above title, for which see page 72



FIG 3 —Deformity of thumb and wrist from scar of burn in child of six years, due to accident one year before



FIG 4 —Plastic operation on thumb, showing condition three months after operation (see Fig 3)  
Notice flap swung from back of wrist and forearm to release thumb

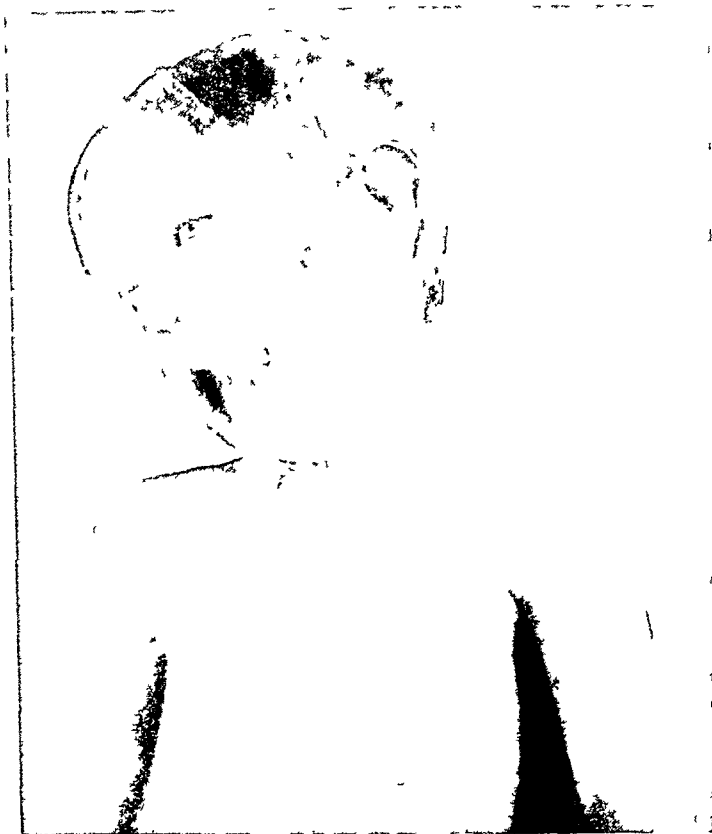


FIG 5 —Deformity of mouth, chin and ear from burn one year previously



FIG 6 —Showing improvement in face three months after operation



FIG 7 —Showing condition of patient of Figs 5 and 6, six years after operations Boy now twelve years old



FIG 8 —Mass obtained from thigh attached to edge of hand to be transferred to nose as a rhinoplastic procedure



FIG 9 —Rhizophyma



FIG 10 —Result of graft after removal of rhizophyma



FIG 11 —Furrow scar of cheek attached to subjacent bone



FIG 12 —Scar freed from bone and cheek filled out by a free transplant of fat taken from abdominal wall

## HISTOLOGICAL EVIDENCES OF GROWTH CHANGES IN TRANSPLANTS

DR DEAN LEWIS, of Chicago, read by invitation a paper with the above title, of which the following is an abstract

There is still considerable discussion as to the histological changes occurring in transplanted tissue of different types and their significance. We know that certain rules must be followed and certain technical errors avoided if the transplantation is to be successful, but we do not as yet know positively upon what the life of transplanted tissue depends. A number of different conclusions have been drawn from the study of much the same material by different men.

Various views have been expressed concerning the fate of the different elements in bone transplants, and in many instances much the same type of experiment has been made and the preparations have been stained in much the same way. One observer comes to the conclusion that periosteum is markedly osteogenetic, while another observer believes that the transplanted tissue acts merely as a scaffolding for developing osteoblasts and that therefore boiled bone, homo- and heterotransplants do as well as an autotransplant. It is difficult to reconcile the different views which have been expressed. The difficulties of interpretation of histological preparations are indicated by the diversity of conclusions arrived at in the study of preparations of much the same kind. It is almost impossible in some cases to correlate histological appearances with function and growth potentialities.

In considering transplants of bone, tendon, fascia and nerves, we find that degenerative and regenerative changes occur in all.

The regressive changes occurring in a bone transplant are dependent upon the physical properties of compact bone which does not permit of early and extensive permeation of serum. The unossified portion of a transplanted segment of bone and the periosteum and contents of the medullary canal, porous spaces and Haversian canals, are readily permeable to lymph and consequently are more apt to live. The compact bone is apt to die. As far as can be determined by histological examination of transplanted bone, the greater part of the compact bone dies, and this is replaced slowly by the so-called "creeping substitution" by bone cells of the compact bone which have not died and by cells from the periosteum and endosteum.

Ivory pegs or dead boiled bone may be used as intramedullary splints, the ends of the fragments being placed in immediate contact or somewhat separated over such a splint. In these cases the peg or dead bone may be replaced by the newly formed bone. Such material cannot be used to bridge a long defect, for substitution, in my experience does not take place in dead tissue used to bridge a long defect.

Degenerative and regenerative changes occur in transplanted tendon. The degenerative fibrillæ in a tendon transplant are replaced by tissue formed by proliferation of the peritendineum externum and internum. The regenerative changes in the transplanted tendon are dependent upon the early assumption of functional activity. Segments of tendon, transplanted into

subcutaneous fat roll up and become shrunken, the fibrillæ becoming distinctly smaller in size and staining poorly, while segments of a tendon transplanted into a defect in a tendon which is made to functionate early undergoes distinct regenerative changes as indicated by an increase in size and distinct histological evidences of growth

All transplants must assume function early William Roux several years ago stated that the fate of transplanted tissue was dependent upon whether or not the transplant was made to assume functional activity

Tissue such as fascia and cartilage which physiologically may be placed rather low in the scale perform a number of different functions, and may be transplanted in different ways and places and still survive Cartilage as shown by Davis transplanted into subcutaneous tissues will survive, while bone transplanted in this way will be gradually absorbed Fascia does not tend to undergo the same changes as tendon The degenerative changes occurring in transplanted fascia, which are mostly fatty, are apparently directly proportionate to the size of the transplant In large fascial transplants transplanted into dural defects fatty changes have occurred in the center with subsequent cicatricial substitution These changes are due to failure of serum to permeate to the center or delayed reestablishment of vascular circulation at this point

Fascia and cartilage may be successfully transplanted into places and under conditions which would result in gradual absorption of tendon and bone transplants

In nerve regeneration the degenerative changes occurring in the distal end of the proximal end and throughout the distal segment are followed by regenerative changes which are very important Degeneration of the axis cylinders and myelin sheaths are followed by proliferative changes in the neurilemma sheaths which lead to the formation of the so-called protoplasmic bands These bands form the conduits down which the regenerating axis cylinders of the proximal stump pass, and are the essential determining factor in nerve regeneration Axis cylinders reform after section of the spinal cord, but do not pass the point of section because no bands are formed and the regenerated axis cylinders form a network at the level of section

Experimental work would indicate that the hyperplastic nuclei of the developing protoplasmic band can grow in vitro, while the resting nuclei die This experiment would indicate that a nerve graft to be successful should be transplanted after Wallerian degeneration has commenced

After the neurilemmal nuclei has passed back to the resting stage it is doubtful whether the protoplasmic band stage can be reproduced again, and this may account for the number of failures of secondary nerve suture after the lapse of considerable time

Roux's law has much to do with the fate of a transplant and failure to keep it in mind accounts for the many different conclusions which have been drawn concerning the fate of transplanted tissue Interpretations of the histological findings often differ because of the difficulty of correlating structure and function

# TRANSACTIONS OF THE NEW YORK SURGICAL SOCIETY

*Stated Meeting, held February 14, 1917*

The President, DR CHARLES N DOWD, in the Chair

## MYOSITIS OF CHEST WALL

DR JAMES M HITZROT presented a man, twenty-six years of age, who was admitted to the New York Hospital, December 27, 1916, complaining of a swelling on the left side of his chest. His present illness began December 7, 1916, with chilly sensations, fever, and the appearance of a tender mass over the left side of the chest near the edge of the ribs. The mass was soft, not red nor inflamed. It was acutely painful, "like a boil," and he was unable to take a deep breath or move the left arm freely. He was sent to the University Infirmary at Ithaca, where an X-ray examination was reported as negative. The Wassermann was negative and his blood count was stated as not normal. Under ice-bags the mass became firm and the pain and swelling decreased somewhat. He was in the Infirmary two weeks, with an evening temperature of  $101^{\circ}$  during that time. There was no history of injury and no local infection elsewhere. His past and family history gave no essential features for consideration. On examination there was a swelling about 12 by 10 cm over the cartilaginous portion of the eighth, ninth, and tenth ribs, extending back along the ninth rib on the left side (Fig 1). The swelling was symmetrical, the skin normal in appearance, not reddened. The mass was made more prominent by any movement which projected the ribs forward. It was not altered by coughing, the skin over it did not feel hot and was freely movable. The swelling was not particularly tender, was firm, hard, not fluctuant, and could not be readily defined at its margins. His blood count was: Hæmoglobin, 81 per cent, red blood-cells, 5,652,000, white blood-cells, 17,000, polymorphonuclears, 62 per cent, small mononuclears, 32 per cent, large mononuclears, 3 per cent, transitional types, 3 per cent, with no abnormal cells. An X-ray picture showed no recognizable lesion in the ribs. The diagnosis was not obvious. Some infectious process beginning in the rib seemed most probable, although a careful X-ray examination showed no bone lesion.

*Operation*—On December 30 a 5-inch incision was made over the swelling in the line of the ninth rib. When the muscle plane was exposed the fascia was œdematous. The muscle itself was grayish white in color, very firm, almost cartilaginous in character, and very markedly altered. The external oblique muscle was about three to four times its normal thickness in the involved area. The underlying bone was uninvolved. At one point



in the cartilage there was a little pitted area which did not look normal. This was excised, although the cartilage did not seem to be involved. The wound was then packed wide open after taking a piece of muscle for histological examination and a culture from the oedematous fascia. The pus gave a pure culture of *staphylococcus aureus*. The pathological report by Dr. Elser was *interstitial myositis*, with extensive infiltration of the muscle bundles and alteration in the muscle fibres. The section of cartilage removed showed no pathological change.

### CENTRAL FRACTURE OF THE ACETABULUM ANKYLOSIS OF THE HIP DUE TO BONY FUSION BETWEEN THE GREAT TROCHANTER AND THE ILIUM

DR. HITZROT presented a man, aged thirty-two, who was admitted to the New York Hospital, January 6, 1917, with a history of an injury to his left hip, August 9, 1916. He was taken to a hospital and kept in bed for four weeks and discharged one week later. He states that X-ray plates were taken and that they showed that nothing was broken. Upon examination at the New York Hospital it was seen that the left hip was ankylosed, there being no motion in that joint. The left trochanter was more prominent than the right and seemed closer to the midline. The left leg was apparently shorter than the right. Measured from anterior superior spine to internal malleolus the left leg measured 13 cm. longer than the right. The region of the great trochanter was occupied by a bony mass which prevented making any accurate estimation of its relation to Nélaton's line, Bryant's base line, or the projection line of Schumacher. An X-ray picture showed a fracture of the acetabulum with projection of the fractured area into the pelvis and apparently bony repair of the fracture (Fig. 2). Between the trochanter and the side of the ilium was an ill-defined mass of bone which was not correctly interpreted until after the operation.

*Operation* (January 12).—Through an obtuse angle incision from below the outer superior spine to the trochanter and then down the thigh the region was exposed. The trochanter could not be definitely outlined, as its top was capped by a mass of new bone. The neck of the femur was then determined, and with an osteotome the trochanter, etc., was cut away from the shaft, after which rotation and flexion of the femur was readily obtained. The trochanter, however, could not be moved, as it was firmly fixed to the rim of the acetabulum. It was freed by an osteotome and removed after separating the attachments of the external rotators and the gluteus medius. These muscles were then attached to the periosteum of the shaft by chromic stitches and the wound closed. A small rubber tissue drain was inserted.

The wound healed by primary union and the patient was up and about on the fifth day after operation. Since that time motion has constantly increased and the patient goes about more satisfactorily than before. It is yet too early to determine the final outcome of the case. The specimen



FIG 1 —Showing location and appearance of a localized myositis of the left chest wall

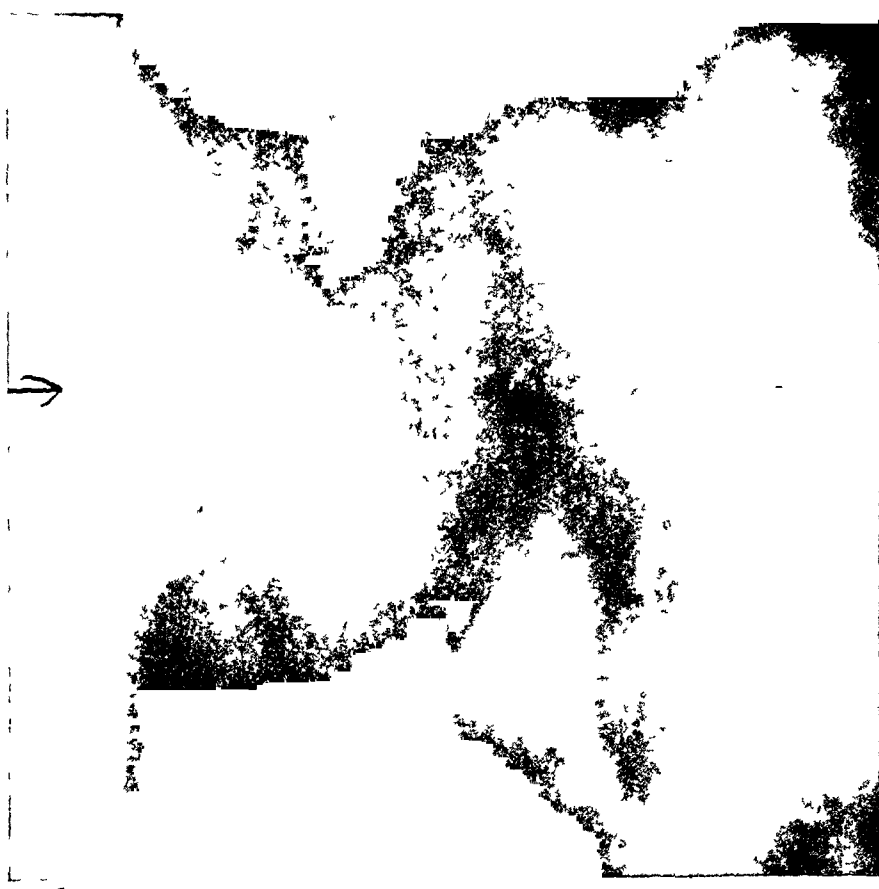


FIG 2 —Central fracture of the acetabulum, repair with ankylosis



FIG 3—Diacondylar fracture of humerus, lateral view



FIG 4—Diacondylar fracture of humerus, anteroposterior view



FIG 5—Showing results obtained by arthroplasty

## FRACTURE OF RIGHT HUMERUS

removed consists of the trochanter, a mass of new bone between it and the ilium, and a small portion of the ilium just above the acetabular rim, and shows the cause of the ankylosis

The case is shown as a rather rare type of injury, with an especially rare complication, namely, the union between the ilium and the trochanter. Motion at the hip as an early essential of his treatment, had the condition been recognized, might have kept the two bony surfaces from uniting as they did

### COMPLICATED DIACONDYLAR FRACTURE OF THE RIGHT HUMERUS (OLD) ARTHROPLASTY

DR HITZROT presented a man, aged twenty-nine years, who was admitted to the New York Hospital December 30, 1916, with a history that, sixteen days before admission, he had fallen about twelve feet, landing on the palm of his outstretched right hand and causing a fracture at the right elbow. He states that the skin over the outer side of the arm was broken and the bone was protruding. He was taken to a hospital and the arm was bandaged on a straight splint. Examination showed a complicated fracture at the elbow-joint, involving the lower end of the humerus, with displacement of the fragments and the joint posteriorly. The X-ray showed a diacondylar fracture with comminution and splitting of the articular surface and displacement and rotation of the trochlea internally and the capitellum externally and the posterior displacement of the fracture (Fig 3). On January 5, 1917, twenty-two days after the injury, he was submitted to operation because anything except open operation could not produce a satisfactory result.

A four-inch incision was made over the external aspect of the arm, exposing the site of the fracture. The lower end of the humerus, the fractured bone fragments, and the olecranon were found posterior in a position similar to that in a posterior dislocation. The capitellum was displaced outward, rotated postero-externally, and there was a mass of new bone on the posterior portion of the humerus which bridged the gap between the fracture and the shaft proper. The new bone and the capitellum were removed. A three-inch incision was then made over the internal aspect of the joint, the ulnar nerve exposed and retracted, and the fragment of the trochlea, which was displaced inward with the articular cartilage pointing down and in and the fractured surface pointing up and back, was exposed. This, likewise, was united to the shaft of the bone by a mass of osteoid tissue. The trochlea was then removed, as was the new bone. The lower end of the humerus was dislocated into the external wound and a thin chip of fractured surface removed with the saw. With a gouge an olecranon fossa was made in the expansion of the humeral shaft. A piece of fascia lata, measuring about 10 x 7 cm, was then taken from the right side of the thigh. This was carefully approximated about the lower end of the humerus and fastened in position with chromic stitches. The olecranon fossa was

then placed in contact with the lower end of the humerus so that the elbow-joint was reconstructed. The wound was closed in layers, using a piece of rubber dam drainage from the upper angle of the outer wound, and the arm was put up in anterior molded plaster splint. The condition found at the operation did not permit of reduction and an arthroplasty had to be resorted to.

His convalescence was uninterrupted (Fig 5). He was carrying a weight and using his arm without a splint two weeks after the operation. It is yet too early to determine the amount of function which will result, and the case is shown to arouse some discussion as to the most appropriate method of handling any injury of this particular type.

DR HOWARD LILIENTHAL said that he had performed arthroplasty in cases of this kind and had noted excellent functional results without the interposition of fascia. While the fascial interposition may be of benefit, its value does not appear to have been proved.

DR WILLIAM DARRACH agreed with Dr Lilienthal. He thought in these elbow fractures it certainly is worth while to try simple removal of the fragments if it is impossible to replace those fragments, even after twenty-two days it is quite well worth trying to replace the fragments in position.

#### RESULTS OF PULMONARY LOBECTOMY

DR HOWARD LILIENTHAL presented three patients to illustrate the end-results following pulmonary lobectomy. The first patient, a boy, six and one-quarter years old, was operated February 22, 1914, the entire right lower lobe having been extirpated. His history was reported in the ANNALS OF SURGERY, June, 1914, and July, 1916, and now, three years after his operation, with the exception of the cicatrix the boy looks perfectly normal and symmetrical and that all the motions of body and arms are possible.

The second patient, a boy ten years old, was operated March 4, 1915, and reported in the ANNALS OF SURGERY, July, 1916. The right lower lobe was extirpated for indurative pneumonia with bronchiectasis and peribronchial abscesses. The X-ray appearances in both these cases were those of lower lobe infiltration. In the last patient a little pus had been withdrawn by another physician through an aspirating needle, and the case was supposed to be one of empyema, the differential diagnosis being made by the X-ray. In both these cases the operation was performed through a wide, seventh-space intercostal incision, using the rib-spreading retractor. The hilum of the lobe was crushed and then ligated and carbolized, the stump being steadied by means of a chromicized catgut suture which was led out of the wound and held in place by means of a safety pin, this to prevent so-called mediastinal flapping. This second patient also is normal in development and has perfect function of chest and arms.

The X-ray in the second case shows, now two years after operation, a chest almost normal.

## EXPLORATION OF THORAX IN EMPYEMA

The third patient, B, is a woman forty years old. She had been suffering for more than two years from lung abscess and suppurative bronchiectasis of a non-tuberculous nature following a tonsillectomy in general anæsthesia. She was referred by the late Dr. Charles H. Richardson. The patient was coughing up tremendous quantities of pungently foul sputum, she said as much as a quart in twenty-four hours. Her case was, indeed, desperate. She was not able to keep house, and whenever she found a boarding place she was soon asked to leave. The X-ray in this case showed a dense shadow in the middle and lower lobes of the right lung. The left chest, except for a few shadows which indicated bronchial glands, showed nothing abnormal. She was operated upon in Mt. Sinai Hospital, Private Pavilion, on October 18, 1915, about a year and a half ago. The case has been fully reported in the *ANNALS OF SURGERY*, July, 1916. The incision here was in the seventh interspace, but here a long piece of the eighth rib was removed with its periosteum in order to gain space for the rib spreader and also the seventh and sixth ribs were divided posteriorly for the same reason. A large piece of the middle lobe and part of the lower lobe were removed with the aid of chain ligatures of chromicized catgut, section being made close to the hilum and about one-third of the middle lobe being removed. In this case there were numerous adhesions of the upper lobe to the chest wall which were not disturbed. A considerable abscess cavity lay between the upper part of the bronchiectasis in the middle lobe and the lower part of the upper lobe. Following the operation there was an immediate cessation of cough and expectoration. During convalescence there were, as in the second case shown, a few slight hemoptyses. Now she is perfectly well, with function of chest and arms completely restored. The only deformity is that of the large cicatrix, where there is some contraction on account of the removal of the rib.

This patient and the one preceding developed bronchial fistulæ when the ligature of the stump came away. Both fistulæ closed spontaneously.

The principal reason for demonstrating these patients was to show the restoration of function and the beautiful symmetry following this operation when performed without multiple rib resection.

## EXPLORATION OF THORAX IN EMPYEMA

A fourth patient was presented to illustrate the importance of complete exploration of the thorax in certain cases of empyema. The patient, a woman, twenty-eight years old, had fallen into the water and had been rescued in a nearly drowned condition. She must have aspirated a considerable quantity of water. About a week afterward she became very ill, and the case was finally diagnosed as empyema, and an operation of the usual rib resection and drainage type was performed by another surgeon. It was said that a large quantity of pus had been evacuated. However, she continued to be very ill, being in a typhoid state, cyanotic, and weak, and the temperature rising as high as 104°. She was then referred to Dr. Lilienthal by Dr. William S. Thomas, and entered his service at Mt. Sinai.

Hospital Théré, on examination, he found a good-sized drainage tube in the patient's left chest through a rib resection opening in the posterior axillary line in the seventh space. Realizing that there was little to lose and that a complete exploration might disclose some unrelieved condition, he decided to operate.

Operation in gas and oxygen anæsthesia on October 4, 1916. Long intercostal incision with retraction by rib spreader. The pus within the chest was rather thin and yellowish in color. The tube drained the main cavity of the thorax, but there was a massive adhesion of the outer part of the lower lobe posteriorly, and when this was broken down a cavity containing about five ounces of thick green pus, quite different in character from that in the general cavity, was entered. On careful sponging and perfect exposure a small opening into the lung was found. The cavity was packed and the tube removed from the general thoracic cavity, no tube being employed for drainage. Another piece of the seventh rib posterior to the original section was now removed for purposes of drainage and the greater part of the wound was closed by suture. For a long time the patient was septic and for several days delirious. Gradually, however, things cleared up and she was discharged on January 11, 1917, well, except for an extremely minute bronchial fistula not large enough to warrant her wearing a surgical dressing of any kind. She has returned to her work.

#### RESECTION OF THE CHEST WALL FOR SARCOMA

DR LILIENTHAL presented a girl, nineteen years old, who was admitted to Mt Sinai Hospital on October 31, 1916. Her illness had begun about six months before her admission. After a thorough study in the case, Dr Brill, in whose service she was, transferred her to the surgical service. Six months before admission she developed pain and tenderness in the right chest. The pain was worse on deep inspiration. It disappeared for a few days and then recurred about twice a week until six weeks before admission, when it became very intense. There were no chills, no fever, no night sweats, no cough, and no expectoration nor hæmoptysis. Physical examination showed dulness in the right chest posteriorly below the angle of the scapula. The blood showed 24,000 white blood-cells, 88 per cent polymorphonuclears, 8 per cent small lymphocytes, 3 per cent eosinophiles, transitionals 1 per cent. On admission the temperature was normal. Pulse and respiration also normal. The X-ray showed a circumscribed tumor in the posterior chest wall, involving the sixth and seventh ribs, the seventh being rarefied and apparently fractured. The shadow was globular in shape. Von Pirquet examination negative.

On November 6, 1916, in ether anæsthesia, an incision was made in the posterior part of the chest in the seventh interspace, opening into a free and apparently normal pleural cavity. The finger passed into the chest showed a rounded lobulated tumor projecting inward and not involving the lung. Sections of the sixth and seventh ribs were now removed with the periosteum and intercostal muscles, the anterior section being made in the

## RESECTION OF CHEST WALL FOR SARCOMA

midaxillary line and posterior section behind the angles of the ribs. The two resected pieces of ribs were removed, and with them the tumor and all such soft parts as were adjacent, the pleura, intercostal muscles, etc. The lungs appeared perfectly normal. So far the operation had been performed under ether administered by the ordinary method, but now when it became necessary to distend the lungs previous to closure of the wound the operator was glad to have the assistance of Dr. Ware, who performed intrapharyngeal insufflation with a foot bellows, distending the lungs perfectly, the anæsthesia up to this time having been administered by a member of the house staff. The external muscles of the chest were now approximated with chromic catgut sutures and the skin was closed without drainage by interrupted and continuous silk sutures. Before the chest was closed by the last suture Dr. Ware inflated the lung so as to exclude intrapleural air. The patient stood the operation well, but there was a period of anxiety because of a post-operative psychosis which developed and continued for about a week. The diagnosis in this case, made by Dr. Mandlebaum, Director of the Pathological Laboratory, was "round-cell sarcoma."

This patient received a few injections of Coley's toxins post-operative, and was also treated by deep X-ray therapy. A few external applications of radium were also made by Dr. Bissell, the patient's family being anxious to omit nothing which might contribute to the permanency of her cure.

The patient has thus far remained free from recurrence and is able to attend to her occupation, that of dress model.

DR CHARLES N. DOWN said that the cases of lobectomy which Dr. Lilienthal had shown form a very important group. One very remarkable element should be noted, the mobility of the chest wall. It is much greater than in patients who have had extensive rib resections.

He inquired of Dr. Lilienthal whether old cases of empyema could be cured by cutting between the ribs.

DR LILIENTHAL replied that in old empyema with sinus it has been his practice to make an intercostal incision large enough to admit the rib-spreading retractor, and if, because of the rigidity so frequent in these cases, good exposure is not possible, he did not hesitate to divide one or more ribs upward or downward from the posterior angle of the wound until the rib-spreader can be effectively used. After then mobilizing the lung the parts may be permitted to drop back to their former position and the disadvantages of the various caving-in-thoracoplasties are avoided.

As to the size of the piece of lung removed in the case of the third patient, he would say that *in situ* the part was about the size of a small adult fist. A considerable collapse takes place, however, when the resected lung is removed from the body.

As to his mortality, he should say that it was in the neighborhood of 60 per cent, but he had not tabulated his cases for some time. The operation should only be performed in such cases as are considered not only incurable by other means, but in which it is pretty clear that without operation a fatal outcome is certain. His excuses for losing patients were varied.



Some have been badly selected and were not suitable for this kind of surgery. Others have died of pneumonia. One patient, a child, in which he had resected the upper and lower lobes of the right lung, was doing well five days after operation and it unfortunately fell out of bed and died a few hours later, probably due to the tearing loose of the steadying suture and the occurrence of mediastinal flapping. Unfortunately no autopsy was permitted. When it is realized that only about one-third of these patients who are operated upon by merely palliative procedures are saved, an equivalent percentage of recoveries, *with complete restoration to health*, is, after all, an advance. Dr Samuel Robinson advises dividing the operation in two or more stages and performing rib resection with the consequent caving in of the thorax. It may be that some method between the one which that surgeon employs and that which he had reported may turn out to be the method of choice.

#### INGUINAL HERNIOTOMY UNDER NOVOCAINE ON THE SEVENTH DAY POST PARTUM

DR SETH M. MILLIKEN presented a woman, aged twenty-eight, who, in March, 1916, was found to have a right indirect inguinal hernia.

As she was then six months pregnant, she was advised to be careful and to have an operation after the delivery. She was normally delivered June 12, 1916. Puerperium perfectly satisfactory. Seven days later the operation under 5-10 per cent novocaine with adrenalin was done.

A glovefinger-like congenital sac was easily removed and the canal closed *in toto*. The time from the first injection to the last stitch was forty minutes.

The nursing of her baby was uninterrupted and the skin sutures were removed on the fifth and seventh days.

She was treated as a normal obstetric case after the fifth day post-operative, that is, she was allowed to sit up in bed on the fourteenth day of puerperium and was allowed out at the end of four weeks.

It seems well worth while to use this method in such cases, for in this case the hernia operation was hardly more than a momentary inconvenience in the course of her obstetric recovery.

#### SUBACROMIAL BURSTITIS

DR FREDERIC KAMMERER presented an adult woman, who, during the summer of 1915, slipped while walking and with considerable difficulty prevented a fall. For six weeks following the accident she had constant, moderate pain over the right shoulder, but she was able to follow her profession as a trained nurse. At the end of this time she woke up one morning with severe pain in the anterior portion of the shoulder-joint, which grew worse, until it entirely incapacitated her. Three days later an X-ray picture was taken which showed a distinct calcareous deposit over the greater tuberosity. Pain and disability became more pronounced. An incision was made through the deltoid muscle about a week later. On incising the outer

wall of the bursa the calcareous deposit beneath its inner wall was neatly exposed, projecting into the lumen of the bursa. A circular band of adhesions around the latter was readily separated with the finger, and the bursa was then opened wide. After cutting through its inner wall the semi-fluid, whitish deposit was exposed and removed. In part it lay between some fibres and the supraspinatus tendon. The individual layers were now closed with sutures and the arm fixed in abduction for a week. Massage, passive and active movements, continued for three weeks more, fully restored the usefulness of the limb.

DR JOHN ROGERS said that such bursal inflammations are probably much more common than is generally believed. They frequently pass under the diagnosis of "rheumatism," and consequently have the same outcome or spontaneous recovery.

A number of years ago he attended a rather nervous woman who had a typical case of this condition, including the calcareous deposit shown in the radiograph. The pain persisted for a couple of months and then gradually subsided. She refused operation, and finally, without any treatment, made a perfect recovery.

DR JAMES HITZROD agreed with what Dr. Rogers had said about the frequency of this lesion. It is quite common and is especially common in baseball players. The symptoms are intermittent in character. Any strain upon the external rotator tendon will, however, bring back the symptoms, and an individual with this calcareous change in the tendon will have trouble in getting the arm over the head and especially in movements requiring rotation at the shoulder-joint.

To call the lesion a subacromial bursitis is a misnomer. The lesion lies in the tendon of the supraspinatus muscle beneath the posterior wall of the bursa or in the bone in those cases in which a fragment of bone has been torn loose, and one has to go through the posterior wall of the bursa to reach the real lesion.

Operation is indicated in the severe cases and apparently relieves the condition. In isolated cases after operation the same motions which caused the pain before operation will be painful, and an X-ray at this period will show no deposits in the tendon.

DR H. H. LYLE said that he wished to emphasize the point that the presence of a calcareous deposit does not necessarily indicate operation. Such calcareous deposits often disappear under conservative treatment. He had the privilege of seeing a case of double calcareous deposits following trauma. After trauma to the right shoulder a subdeltoid bursitis arose. A radiograph showed a calcareous deposit in the bursa. The patient was treated by conservative means, and the bursitis and the calcareous deposit disappeared entirely. Strange to say, the patient developed a similar condition in the left bursa. This was treated in a similar manner and the same results obtained.

Attention has been called to this condition by Dr. Hoffmeister, of Germany, Dr. Berry, of Albany, and Dr. Morris K. Smith, of New York.

DR HOWARD LILIENTHAL said that for about thirteen years he himself suffered from all the symptoms of so-called subacromial bursitis of the left shoulder. Finally, when the trouble began in the right shoulder and the disability became truly serious, he was treated by scientific massage with the happy result of perfect restoration of function. Since then he had seen a number of these cases. He had operated in only one, and, although the patient was temporarily relieved, there was a recurrence of symptoms later on. In his own case no X-ray was made, so he was not sure whether or not there was lime deposit. In another patient, however, in which there was great pain and disability and in which, as in his own case, heat, medicines, and other remedies had failed, a cure was also effected by massage. He had seen perhaps six of these cases exclusive of the man upon whom he operated and all were relieved by massage. It appeared to him that operation should indeed be the dernier resort in the therapy of subacromial bursitis.

DR ALEXIS MOSCHCOWITZ said that his associate, Dr. Brickner, had paid a great deal of attention to cases of subdeltoid bursitis, and, as a matter of fact, all cases are more or less turned over to him at the present time for treatment and operation also.

He had seen a number of these cases. He had watched particularly operations by Dr. Brickner and all of these cases have shown calcareous deposits in or about the tendon of the supraspinatus. These cases have been examined pathologically by Dr. Eli Moschcowitz, sections have been made and examined very carefully and it can be shown that the calcareous deposit has been in the tendon.

DR WILLIAM DARRACH disagreed with Dr. Hitzrot's statement that the calcareous deposits always lay beneath the deeper layer of the bursa. He had cut down on one in which the calcareous deposit was between the muscle and the superficial layer of the bursa. He thought there are two distinct classes here, one the acute bursitis and the other the tearing fractures of the greater tuberosity lifting up a projecting fragment of bone, which is the cause of the irritation of the bursa.

Certain of the X-ray pictures in these cases show a very distinct tearing off of a little elevation from the tip of the greater tuberosity. He had cut down on two cases where, as the bursa was opened, could be seen projecting forward a sharp spicule of bone due to the lifting off by the supraspinatus tendon of a portion of this greater tuberosity, leaving a sharp spicule there which extends almost through the deeper layer of the bursa. These form one distinct group in which one can get a traumatic history.

In some of the other cases without a distinct traumatic history, the condition is more likely to be a true bursitis. The majority of the cases will subside after a certain length of time, anywhere from three to six months, if they are massaged or if they have the proper form of motions after the acute symptoms have been allowed to subside with rest. Rest until the acute symptoms have subsided and then proper massage and motions will cure a great many of them, but there are a great number in which the acute symptoms persist or recur in spite of everything.

## HYPERTHYROID GOITRE WITH PNEUMOCOCCUS ABSCESS

In one case operated upon by him last summer the acute symptoms had persisted for a year. The woman was almost unfit for work and frequently had no sleep at all. The most marked case he had ever seen as far as the calcareous deposits go was a man who had a very large calcareous deposit which on X-ray seemed to be a centimetre in thickness. He advised him strongly to have an operation, which he agreed to, as soon as he got back from abroad. He was held up on the other side longer than he expected and when he got back his shoulder was better and one year later he was able to play a very good game of golf and he has not been operated on and has no symptoms at the end of two years. An X-ray has not been taken recently.

## HYPERTHYROID GOITRE WITH PNEUMOCOCCUS ABSCESS

DR CLARENCE A McWILLIAMS presented a woman, K. B., fifty years of age, who had had four children and four or five miscarriages, and who came into the Presbyterian Hospital in July, 1916, complaining of swelling in front of neck, nervousness, palpitation of the heart and loss of strength. She did her own housework for a family of seven. Her mother had a goitre for over fifty years and a sister has had a goitre for several years. The patient is a native of New York City and has always lived here except for four years in New Jersey. Thirty years ago, after the first child was born, she noticed a fulness in the front of the neck just above the sternum, which caused no trouble whatsoever. It seemed to grow a little with each confinement. Seven months ago patient had a severe sore throat, following which the goitre became enlarged, swollen, tender and painful, and for which ice-bags were applied. The pain disappeared but the swelling persisted. During the past seven months the patient has had four attacks of tenderness of the right side of the goitre, lasting about a week each. The present attack of tenderness and increased swelling began about two weeks ago and both have persisted since. For a number of months she has tired very easily, she has palpitation and she feels her heart flutter. She is much more nervous than formerly and is easily excited. She perspires much more, her hands are unsteady. Her weight decreased from 165 pounds to 130. For the past four months she has been receiving X-ray treatments at Mt Sinai Hospital without any benefit. There was no history of dyspnoea nor obstruction to breathing, diarrhoea nor chills. Examination shows marked enlargement of the right lobe of the thyroid. This is very tender, firm and nodular and hard. Isthmus also enlarged. Left lobe not enlarged. There is no pulsation nor bruit over the left lobe. Pulse averaged about 110, was regular with no murmurs. The blood-pressure was systolic, 168, diastolic, 90. The blood count was 6600 and polymorphonuclears 53 per cent. X-ray picture of the chest showed no enlargement of the thymus nor did the goitre extend down below the upper extremity of the sternum. The successive attacks of pain, swelling and tenderness in the hyperthyroid goitre were explained

on the basis that successive hemorrhages had taken place in the goitre at various times. The temperature for five days prior to operation averaged  $100.5^{\circ}$  and the pulse 110.

On July 26, 1916, a right hemithyroidectomy with excision of a nodule in the isthmus was performed under nitrous oxide and oxygen anæsthesia preceded by a hyoscine and morphine hypodermic injection. No ether was used. The external fibrous capsule was most adherent to the whole gland, particularly above and posteriorly. After splitting the capsule vertically in front, with great difficulty the right lobe was shelled out with the finger. This adherence was erroneously supposed to be due to the previous influence of the X-rays, since no pus was encountered during the operation at any time. There was a prolongation of the upper pole which extended behind the trachea. This was worked out with difficulty with the finger, owing to its adherence. The lobe was hard, suggesting carcinoma, and nodular and was probably four times its natural size. The hemorrhage was not troublesome. A nodule, size of a walnut, was removed from the isthmus, and the right lobe was removed. The left lobe seemed fairly normal, so it was left. A goitre drainage tube was placed in the cavity left on the right side. The operation lasted fifty minutes. The patient was in good condition, though the pulse was 160, requiring no stimulation.

On sectioning the lobe immediately after the operation an abscess cavity  $3 \times 2 \times 2$  cm. was opened, containing about a drachm of thick, light brownish, odorless pus. Culture from this gave pneumococcus group IV. The infection of the lobe was probably responsible for the adhesion of its capsule rather than the X-rays.

*Pathological Examination*—Gross Specimen. There are 2 specimens. (1) The right lobe of the thyroid tissue,  $4 \times 2 \times 2$  cm. Cross-section of right lobe shows an interesting condition. In the anterior surface is what appears to be a broken-down area of tissue forming a cavity  $3 \times 2 \times 2$  cm. The wall of this cavity appears to be made up of thyroid tissue and scattered through the tissue immediately adjacent to it appears to be a material similar to that seen in a hypernephroma. Scattered through the cut-surface of the lobe, the tissue varies a great deal in appearance, markedly colloid in places, in others apparently adenomatous.

*Microscopic Examination*. The microscopical picture varies considerably in the different parts of the gland. Sections from the nodular masses in the thyroid show a picture of adenomatous hyperplasia which in place approaches a carcinomatous type. But from a mere pathological examination, it is believed impossible to make an absolute diagnosis. It may or may not be malignant. Only the follow-up notes, three to five years from now, will answer the question. Inasmuch as all of the lobe on the right side and the isthmus has been removed, and inasmuch as sections from the isthmus show nothing more than adenoma, further operative procedure is not advised. Sections from wall of abscess show a rather chronic inflammatory process. There were a great many round-cells as well as polynuclears. There are also a few giant-cells, but they are not grouped typically, nor are there other evidences of tuberculosis.

*Diagnosis*—Adenoma of thyroid. Abscess of thyroid (Pneumococcus, group IV).

## ACTINOMYCOSIS OF PHALANX OF FINGER

*After Result*—On the second day after the operation the patient had severe pain in the left cheek and over left mastoid. The left parotid became swollen and exquisitely tender. There was only a degree elevation of temperature and the leucocytes were 8000. Diagnosis of parotitis was made which finally subsided without incision under the use of ice-bags.

Result after five months. The patient has improved very much. She has gained weight. She sleeps and eats well, is not nervous nor tremulous. Her heart does not flutter, though it averages 100. She has her full strength and vigor. The left lobe of the thyroid has increased in size and is now distinctly palpable. With any recurrence of the symptoms of hyperthyroidism removal of half the left lobe would be in order.

Patients with suppuration of the thyroid gland are comparatively rare. Only three cases of suppuration in the thyroid gland have occurred in the Presbyterian Hospital, in only one of whom was the suppuration associated with goitre. The second case was a woman of twenty-three who had had a swelling and pain for a week in right lobe of thyroid. Highest temperature  $100^{\circ}$  with leucocytes 18,000 and polymorphonuclears of 8470. Six ounces of thick, yellowish pus were evacuated from the right lobe. Cultures were sterile. Recovery. The third case was a man of thirty-two who had been treated for syphilis and had a 4+ Wassermann. Four days prior to his admission he was seized with stabbing pain in left side of neck. Noticed no swelling in neck. On palpation there was deep induration over the left lobe of the thyroid. His temperature was  $104^{\circ}$ , leucocytes 14,000 and polymorphonuclears 80 per cent. At operation the thyroid capsule was oedematous and in the left lobe there was an abscess containing one and one-half drachms of very foul pus, fetid, such as occurs in the mouth and teeth. Recovery. Culture showed streptococci hæmolytica.

## ACTINOMYCOSIS OF PHALANX OF FINGER

DR CLARENCE A. McWILLIAMS presented a man twenty years of age, whose chief complaint was of pain in the bone of the first phalanx of third left finger. Six months previously he cut the knuckle of that finger on an adversary's tooth. He came to the Presbyterian Hospital Dispensary twice and the cut healed in four days. Two or three weeks later finger began to swell at site of injury. This swelling increased slowly. One month ago began to have pain in swelling. No pain in hand or arm. The pain was dull aching. The function is gradually lessening. Swelling broke down about a month ago, discharging a few drops of pus. This closed again in three days. It is now red and tender. No other points in history have any bearing.

Examination shows that the left hand feels and appears normal in every way except for the third left finger, on both sides of the proximal phalanx of which is a fusiform swelling, slightly bluish colored and tense and brawny with a small scar of the old sinus which is now healed. It does not fluctuate, is only slightly tender. It is attached to the deeper structures

and limits motions of finger only by its size and position. The X-ray (Fig 6) diagnosis was bone cyst of proximal phalanx of the left middle finger. The sinus had closed, so there was no discharge which could be examined. Wassermann negative. Incisions were made on each side of the finger. The soft tissues were evidently changed from the normal, being dirty gray in color and more fibrous than normal tissues, not broken down. No pus was found. A section was taken for frozen examination. The report was sarcoma, so amputation was performed at the metacarpophalangeal articulation. The tendons and sheaths were not involved.

*Pathological Examination*—Gross specimen. Specimen is a middle finger disarticulated at the metacarpophalangeal joint. On either side of the proximal phalanx are incisions down to the bone. On cross section through the middle of the proximal phalanx, the cortex of the bone is exceedingly dense and about 4 mm in thickness. The lateral aspect of the bone has been exposed by the operative incision and is very much eroded. The mesial aspect of the bone is likewise eroded, but not to as great an extent. The tumor does not seem to be at all adherent to the eroded portions of the bone, thus showing that it is pressure erosion rather than a destructive bone tumor. The tumor has no definite outlines but appears to extend the entire length of the proximal phalanx on both lateral aspects. The two masses do not appear to connect with one another. The tendons and tendon sheaths appear intact.

*Microscopic Examination*. Sections from the soft parts of the finger over the proximal phalanx show at several points large collections of round and polynuclear cells forming practically small abscesses. In the middle of one of these is a ring-like body about the size of a pin-head which is amorphous and stains a very deep blue on the inside of the ring, while on the outer side are innumerable closely placed short rods, the ray fungi, which stain red. The spaces between the connective tissue are infiltrated with solid cords of round cells. Section of the phalanx shows very dense cortical bone which is ragged at the edges, showing erosion. At one point in the cortex some trabeculae of new-formed bone are growing out into the surrounding connective tissue. There is no sign of the ray fungus in or about the bone.

*Diagnosis*—Actinomycosis of dorsal and volar surface of finger.

There is but one other case of actinomycosis in the records of the Presbyterian Hospital. This was in the postanal region. The region was excised six years ago. There was a recurrence in three years with a second thorough excision. That was three years ago and up to the present there has been no recurrence.

#### LATE RESULT OF PARTIAL EXCISION OF STOMACH FOR CARCINOMA

DR. FREDERIC KAMMERER showed a patient, whom he had already presented to the Society, once in November, 1900, a few months after operation, and again in December, 1902. The operation, which was done for a carcinoma of the stomach, consisted in the removal of the pylorus, the entire lesser curvature and more than half of the stomach. A Murphy button was employed in reestablishing continuity of the intestinal tract. The speaker stated he had no other cases of resection of the stomach alive five years



FIG 6 — Actinomycotic tumor of phalanx





## VICIOUS CIRCLE FOLLOWING GASTROJEJUNOSTOMY

after operation, and he had, from time to time, seen most of them, unfortunately with recurrences. The greater number had died about two years after operation, some of them had lived for three or four years. Kuttner, who has lately published his results, found 18 per cent of his patients alive from three to seven years after resection of the stomach for cancer. He mentions one case operated on by Kausch, living and well eleven years after resection of three-quarters of the stomach. The patient shown has no recurrence after sixteen years, and he may, therefore, be considered a permanent cure, again demonstrating the fact that the large, palpable tumors are not always the inoperable ones.

## NON-FUNCTIONATING PYLORUS FOLLOWING GASTRO-ENTEROSTOMY WITHOUT PYLORIC OCCLUSION

DR BURTON J. LEE presented a man, fifty-two years of age, who was admitted to New York Hospital, in the service of Dr Charles L. Gibson, two years previously. There had been a history of ulcer of the stomach extending over fourteen years. During the preceding two years the symptoms had been greatly aggravated, with frequent vomiting, associated with gastric pain. Upon admission, patient showed extreme emaciation, with marked general weakness. There was tenderness in the upper abdomen, with indefinite signs of a mass in that region. Preoperative diagnosis lay between neoplasm and ulcer.

Exploratory operation revealed a large mass occupying the pylorus and extending into the lesser omentum, along the lesser curvature. Several nodes which were quite evident upon the greater curvature were removed for microscopical examination. A posterior no-loop gastrojejunostomy was performed, three layers behind and two in front. Pathological examination of the nodes revealed no evidence of malignancy. The man's recovery was normal and he has had a gain in weight of upwards of thirty pounds.

X-ray plates showed the gastro-enterostomy working, with the stomach nearly empty in five hours. Nothing was apparently passing through the pylorus.

The case was presented to bring up for consideration by the Society the wisdom or unwisdom of occluding the pylorus in such cases.

## VICIOUS CIRCLE FOLLOWING POSTERIOR NO-LOOP GASTRO- JEJUNOSTOMY FOR DUODENAL ULCER, RELIEVED BY ENTERO-ENTEROSTOMY

DR BURTON J. LEE presented a man thirty years of age, who was admitted to New York Hospital, November 4, 1916. There had been a history of six years of digestive distress, characterized by pain in the epigastrium, usually relieved by the induction of vomiting. There had never been any blood in the vomitus. The man's symptoms had been very much aggravated during the past two years.

Operation was performed November 4, 1916. A markedly indurated duodenal ulcer was found, just distal to the pyloric vein, apparently involving the posterior wall. A posterior no-loop gastro-jejunostomy was done, three layers behind and two in front. During the first post-operative week recovery seemed satisfactory. Then patient vomited eleven ounces of yellowish fluid and an hour later thirteen ounces of brownish fluid. Lavage was instituted over a period of several days, with relief of the symptoms, but several days later there was a repetition of the vomiting with considerable epigastric distention and distress. On the third of December, about one month following the original procedure, lavage brought away 1900 c.c. of turbid, bile-stained fluid, and the following day 2000 c.c. of greenish fluid was removed in a similar manner. Tests for blood were positive in both these fluids. Patient's general condition was steadily growing worse, with marked emaciation and pallor.

Operation was performed under gas and oxygen anaesthesia. It was found that the jejunum had become adherent to the area of ulceration, making a sharp bend in the gut at this point and causing a definite obstruction, which accounted for the vicious circle established. An entero-enterostomy between the two loops of the jejunum was performed, three layers behind and two in front. Convalescence from that time on was uneventful. The man was given fluid by infusion, hypodermoclysis and by rectum. Five days later he began to eat solid food without discomfort.

The man's general condition is now excellent and his gain in weight has been upwards of twenty-five pounds. X-ray examination by Dr. Busby a week ago showed stomach nearly emptied in three hours, a small amount of barium passing through the pylorus. The man at present has no complaints.

This case is called to the attention of the Society to bring up the question of the frequency of the occurrence of a vicious circle following a gastro-enterostomy and to point out one factor in the causation of the condition.

#### AVULSION OF TENDONS OF THE LEFT FOREARM, FASCIA FLAP INSERT TO OVERCOME TENDON DEFECT

DR. BURTON J. LEE presented a man thirty-eight years of age who was admitted to New York Hospital October 13, 1916, in the service of Dr. Charles L. Gibson. Just before admission his left forearm had been caught in a cutting and rolling machine with avulsion of considerable skin, muscles and tendons from the arm. The man was in a condition of moderate shock and was taken immediately to the operating room, where, under a general anaesthetic, the wound was opened and explored. There was a ragged, lacerated, badly soiled wound on the back of the left forearm (Figs 7 and 8). A portion of the first and second extensor tendons was intact. Other tendons were missing. It was impossible by any plastic procedure to bring the tendons into contact with the muscles. An aponeurotic flap was there-

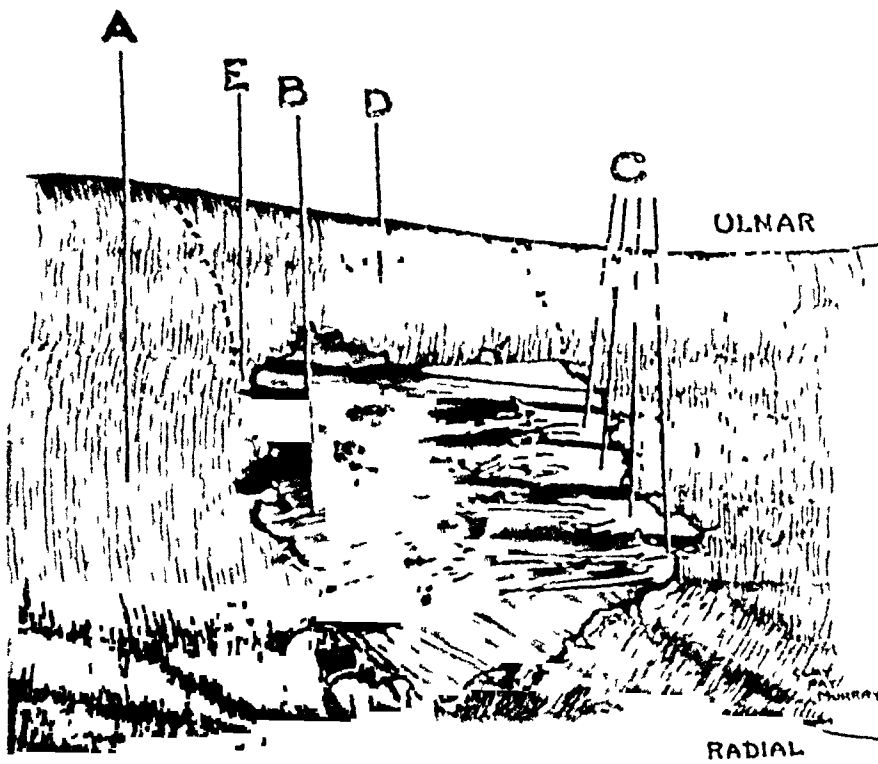


FIG 8 —A, deep fascia of arm B, torn belly of flexor muscle, C, torn tendons of flexor muscle D, dotted line indicating fascial flap, E, pedicle left for nutrition of flap

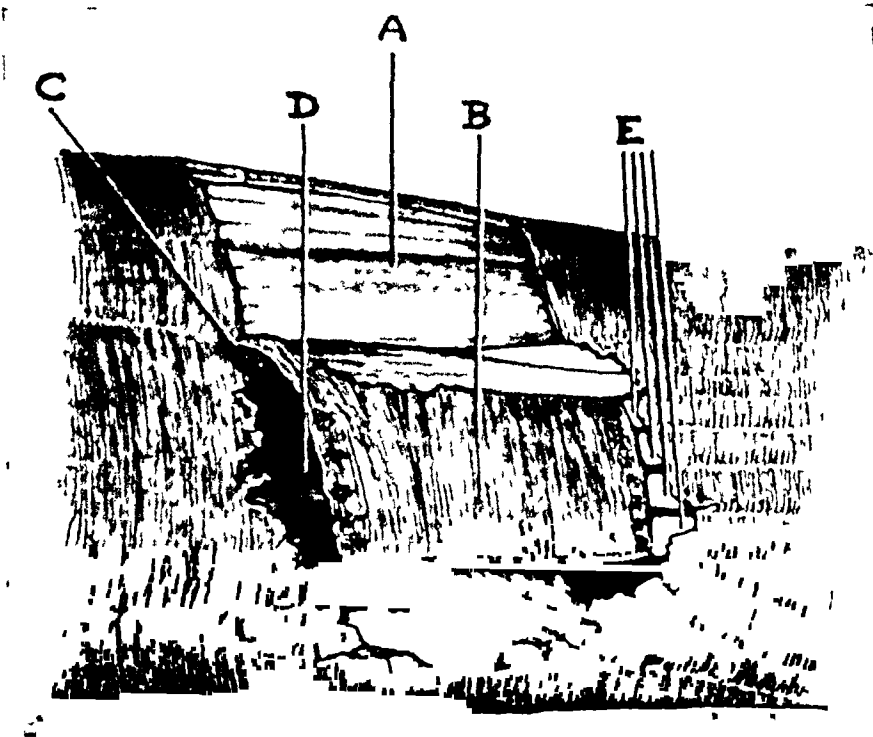


FIG 9 —A, area denuded in formation of flap, B, flap turned down on C, pedicle, and sutured to D, flexor muscle belly, above, and E, flexor tendons, below



fore dissected up from the ulnar side of the forearm, leaving a small pedicle at its upper mesial aspect, the flap being rotated upon itself and made to lie between the muscles and the tendon ends, being sutured above to the muscles and below to the tendons, with interrupted chromic gut sutures (Fig 9) The wound was closed in such a manner that the aponeurotic flap was protected by skin covering. Several small rubber dam drains were placed through openings in the sutured skin wound.

It was believed that the man would very probably lose the function of his extensor communis digitorum from sloughing and suppuration. It was felt possible, however, that the aponeurotic bridge might become effective as tendon and muscle.

The extremity was kept immobilized for six weeks and then passive movements and later active movements were begun, for both wrist and fingers.

The man has now been at work for the past two weeks and can extend his wrist and fingers to a line parallel with the forearm, but no farther. The extensor group is not quite as strong as on the other side and the

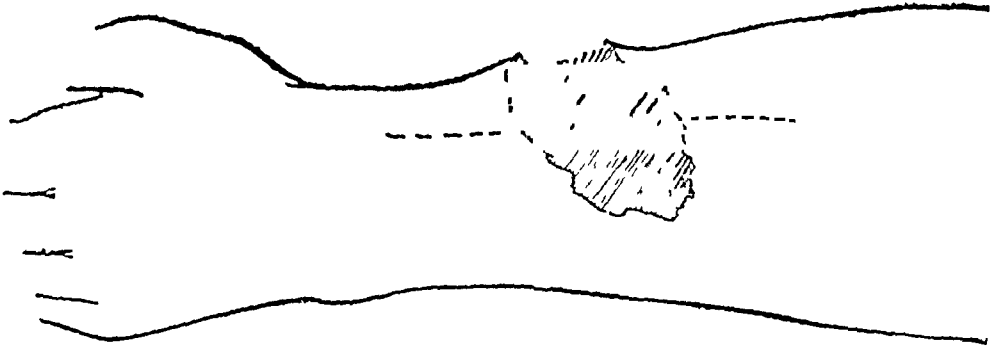


FIG 7 —To denote site of injury to forearm, size of area involved and line of skin incision (dotted line)

inability to completely extend is due to the fact that the fascial flap is a little longer than necessary, preventing full extension power. However, he has a perfectly usable and useful hand. He has, in addition, independent movement for the various fingers. The fairly useful arm which he presents illustrates the possibility of using the aponeurotic flap insert for cases with similar tendon defect.

#### DUODENAL ULCER CURED BY GASTRO-ENTEROSTOMY. RECURRENT OF SYMPTOMS DUE TO NONABSORBABLE SUTURE, DANGLING FROM THE STOMA, AND CURED BY ITS REMOVAL

DR GEORGE WOOLSEY presented a woman operated on by him in 1913 for a duodenal ulcer, doing a gastro-enterostomy in the usual way. She made a good recovery except that she had an unusual complication, a suppurative parotitis. She was well after that for about a year and eight or nine months, then the gastric symptoms returned and in spite of medical treatment, rest and diet, in spite of all that could be done for her, she got no better.

Two X-ray series did not give any very definite information. On opening the abdomen, just two years almost to the day after the first operation, there was nothing abnormal, externally, at the site of the gastro-enterostomy. There was no induration and no adhesions.

The ulcer had apparently healed, so he made an incision into the stomach, and there, hanging from the inner surface of the stoma, was about three inches of black thread. He pulled on this and pulled out three or four inches more. At the point where the thread was pulled out there was no ulcer. He looked for an ulcer in the jejunum beyond this and over the adjacent surface of the stomach, and there was no ulcer to be found, so he sewed up the stomach and the patient made a good recovery and has been well ever since. This was in October, 1915. She is a nurse and has had some tuberculous pleuritic trouble, but in spite of this she was able to get along very well.

Such a case shows the danger of the use of a non-absorbable suture. Since that day he had not used any non-absorbable suture in gastro-enterostomy. No o chromic catgut is quite sufficient for both layers of sutures. In the second place, the symptoms of ulcer were produced here without any demonstrable ulcer. The irritation of this thread pulling on the stomach was the cause of her symptoms, for the relief was immediate as soon as the thread was pulled out.

He had seen a few cases of gastro-enterostomy which, perhaps not as late as this, but earlier after an operation, showed signs of recurrent gastric trouble, which passed away spontaneously, probably after the thread was cast off. In other cases the irritation of the thread may produce a gastro-jejunal ulcer.

DR JOHN ROGERS remarked that there seems to be a well-founded objection to the use of linen or non-absorbable suture material in gastro-intestinal anastomosis. Yet the outer or serous layer of sutures is generally made with linen. Experiments, first performed by Senn, have demonstrated that all non-absorbable suture material of the gastro-intestinal tract is ultimately passed into the lumen of the gut. Hence, if linen sutures of the mucosa layers of a gastro-enterostomy are not advisable, linen sutures of the serosa and muscularis should be equally objectionable. The fact that Dr. Woolsey's case was immediately relieved by removal of the thread is another experiment to prove the advantages, for suture material, of chromicized catgut.

DR EUGENE H. POOL said, in regard to employing a continuous non-absorbable suture in gastro-enterostomy, he had come to the conclusion that it is to be avoided both from experiences in two cases which he had seen himself and from similar experiences which others have reported. In his two cases, posterior gastro-enterostomy was performed, a linen continuous suture was used for the outer layer and a fine chromic for the inner. Symptoms of ulcer developed a few weeks after each operation. The symptoms persisted, and about six months after the respective gastro-enterostomy the abdomen was reopened. In each case an ulcer was found about a centi-

metre and a half in diameter on the jejunal side of the gastro-enterostomy opening, and in each case part of the non-absorbable linen thread could be seen at the bottom of the ulcer. In one case the knot lay on the floor of the ulcer. There was no question in those two cases that the non-absorbable material had influenced the development of the ulcers. In each case the ulcer was rather chronic looking in that the edges were very firm and raised and the floor likewise indurated, as if the ulcer had been there for a comparatively long time.

If interrupted linen stitch had been used, of course a stitch would have been cast off before an ulcer became chronic, and the chances are that a recent ulcer would have healed, but a continuous linen stitch must remain for a long period embedded in the tissues, and the exposed portion acts as a constant irritant.

He has given up entirely using a non-absorbable continuous suture for either row. He uses occasionally a few linen interrupted sutures external to the outer layer of chromic catgut.

DR CHARLES N DOWD said that for a year and a half he had used interrupted Pagenstecher (linen) sutures for the outer row, thus avoiding the danger of long-hanging sutures. He thought this did not add more than three or four minutes to the time of the operation, and that the advantages more than compensated for this time.

#### CHRONIC GASTRIC ULCER RESECTION GASTROJEJUNOSTOMY (POLYA-REICHEL)

DR WOOLSEY presented a woman, sixty-six years old, who has had more or less indigestion for a number of years. For three years previous to last December she had periodic attacks of gnawing pain in the epigastrium, relieved by milk diet for a few days. The attacks were infrequent and in the intervals she was comfortable, but had to avoid fruit and raw vegetables.

At the end of September she had an attack of epigastric pain coming on about an hour after eating, lasting until the next meal and relieved for a time by eating. She never vomited spontaneously, but often induced vomiting to relieve the pain, and she was often nauseated. During this attack, which lasted until December, she lost twenty pounds. Two X-ray series, taken previously, showed a six-hour residue and a pyloric defect. The diagnosis was gastric ulcer. After the second X-ray series she had a very severe attack of bismuth poisoning. A test-meal showed hypersecretion and hyperacidity. Medical treatment, with Lenhartz diet and rest in bed for two months or so, gave no relief.

Midway between the ensiform and the umbilicus there was a palpable, tender mass, the size of a large egg, slightly movable. On operation December 7, 1916, there was found along the lesser curvature, just proximal to the pylorus, a marked induration, with a nodular hard projection, sug-



gestive of new growth The pyloric region was firmly adherent posteriorly and the retropyloric glands were enlarged and firm

He resected the pyloric end of the stomach and sutured the proximal end directly into the jejunum by the Polya-Reichel method She made a very satisfactory recovery The pathological report was chronic ulcer, with no malignant degeneration

One interesting point about this is that the test-meal, taken just before she left the hospital in January, showed a total acid of fifty-six and a free hydrochloric acid of fifty All of the pyloric antrum was removed, showing that the removal of the pyloric end of the stomach does not affect the acid content in the gastric juice She has gained considerably in weight and is very well

PERFORATED GASTRIC ULCER SUTURE WITHOUT GASTRO-  
ENTEROSTOMY RECOVERY RECURRENCE GASTRO-ENTER-  
OSTOMY REPEATED SEVERE HEMORRHAGES FROM THE  
ULCER TRANSFUSION RECOVERY

DR WOOLSEY presented a man, thirty-seven years of age when admitted to the hospital on the first of November, 1915 He gave a history of having, seventeen months before, had a perforated gastric ulcer, which was sutured at Hudson Street Hospital, without gastro-enterostomy Their report was a perforated ulcer, one and a half inches from the pylorus

For the past five months he has had a feeling of heaviness, or a burning and sometimes a griping pain in the epigastrium, sometimes while eating, but most severe before meals, relieved or alleviated by eating Vomiting often occurred about two hours after eating, and this relieved the pain The vomitus sometimes was like coffee grounds He had frequently noticed tarry stools The symptoms had been nearly continuous One hour after Ewald meal, 600 c c were expressed, which gave total acid seventy, free hydrochloric acid fifty, no blood An X-ray series showed a persistent defect in the pyloric region, suggestive of ulcer

On operation November 10, 1915, the pyloric end of the stomach was found adherent by bands to anterior abdominal wall and the lower edge and under surface of the liver A small indurated scar a little proximal to the pylorus was taken to be the site of perforation Posteriorly this region, and the first portion of the duodenum, were much indurated and very adherent to the indurated pancreas behind

Owing to the inherent difficulties no resection was done, but a no-loop posterior gastro-jejunostomy was made with two rows of No 0 chromic gut sutures, and the pyloric end relatively excluded, by infolding, by three rows of mattress sutures On the fourth day after operation the patient had the symptoms of hemorrhage, vomited blood, and soon afterward passed tarry stools Two days later he felt well and hungry, but weak The hæmoglobin was fifty-five per cent, red corpuscles, 1,600,000

The wound healed per priam On the seventh day after the operation he again showed symptoms of hemorrhage and was treated, as before, by morphine, horse serum and hypodermoclysis On the ninth day after operation hæmoglobin ten per cent, blood-pressure too low to count, and patient drowsy and scarcely conscious He was transfused by Dr Lindemann, by his method, receiving 1100 c c When he had received 480 c c consciousness returned and after 1100 c c he looked and felt like a new man Immediately after this he was operated under general anæsthesia

He had in mind a case presented before this Society by Dr Downes that he had re-operated for hemorrhage within twenty-four hours of the operation and had found the bleeding point at the margin of the stoma On going through the old wound and opening the stomach the gastro-enterostomy was found to admit two fingers easily—it might have admitted three It appeared perfectly smooth and entirely healed There was no bleeding point and no ulceration The point of exclusion by infolding would not allow the passage of the finger, though it was not absolutely tight

He was convinced that there was no hemorrhage from the site of the gastro-enterostomy, but to make doubly sure he made a continuous lock suture of chromic catgut around the opening

The man made a fair recovery, although there was a little hemorrhage the next day, and he got quite restless His pulse went up to 130 odd and he spit up a little fresh blood The source of the hemorrhage here, he was very sure, was from the ulcer, not from the gastro-enterostomy He had been bleeding before operation, as he had coffee-ground vomitus and tarry stools before operation

Gastro-enterostomy is not a sure cure for hemorrhages from ulcer, neither is unilateral exclusion, as reported by V Eiselsberg in at least one case where, after his operation of unilateral exclusion, hemorrhage continued

He had a complication after this The opening of the stomach was sutured without inverting, as he usually did, using the "loop on the mucosa" stitch, here he used a lock stitch without inverting, but everting, then buried that with a Lembert suture The man got up a gastric fistula, so the wound broke down, and he now has quite a large hernia The wound healed up spontaneously without further operation, and the patient has been otherwise well ever since

This case is of interest for these reasons In the first place, he had a perforated ulcer He was cured of the immediate effects by a suture operation without gastro-enterostomy, but he had a recurrence of ulcer The addition of gastro-enterostomy would probably have avoided this In the second place, he had severe hemorrhage from the ulcer after gastro-enterostomy, and his life was saved by the *direct transfusion of blood* The second operation revealed no bleeding from the gastro-enterostomy, and was therefore really unnecessary

RELATION OF THE ILIOHYPOGASTRIC NERVE TO THE RADICAL  
CURE OF INGUINAL HERNIA

DR ALEXIS V MOSCHCOWITZ read a paper with the above title, for which see page 79

DR CHARLES N DOWD remarked that it was interesting that a little piece of small nerve could occasion so much discussion. Possibly the amount of discussion is out of proportion to the importance of the subject. But at all events it is helping to clarify one's views of nerve anatomy and nerve physiology and the questions involved in the cure of hernia. The real question must not be befogged by a study of motor and sensory nerves. The real question is, Does the iliohypogastric nerve give off fibres with trophic function within the field of hernia operation? In hernia operations the external oblique aponeurosis is usually split for three inches, more or less, above the external abdominal ring. If the nerve gives off fibres within this area care should be taken to preserve these fibres. This illustration from Spalteholz (Fig 10) may refresh our idea of the anatomy of the parts. It is seen that the lower fibres of the internal oblique muscle run almost transversely from Poupart's ligament to the aponeurosis which forms the sheath of the rectus abdominis muscle. These fibres may act independently of the remainder of the muscle, just as other fibres of the muscle may act independently.

This local action of portions of the abdominal muscles gives the localized rigidity which is so important in diagnosis. It is dependent upon the complex nerve supply. The internal oblique muscle is supplied by at least seven nerves—the lower five thoracic, the iliohypogastric, and the ilio-inguinal. Hence, localized contraction of different parts of the muscle is obtained when needed. He had seen such contraction of the fibres about the internal abdominal ring under electrical stimulation during operation. Where are the nerve fibres which conduct this local stimulation? It would seem self-evident that they come from the nerve which traverses them.

This nerve, the iliohypogastric, traverses the entire breadth of the muscle from the lumbar fascia to the lowermost fibres at the internal ring. It lies, at first, at the under surface of the muscle, then passes obliquely through the muscle fibres, and then lies upon the outer surface of the muscle. According to his view, it gives off small filaments to the muscle fibres throughout this course until it has supplied the filaments to the innermost muscle bundles at the internal abdominal ring. If this is true it certainly should be protected at the locality where these filaments are given off. His reasons for believing this anatomical arrangement are as follows:

- 1 It is the natural arrangement and corresponds to the nerve supply in other parts of the body.

- 2 Anatomists describe such an arrangement. For example Spalteholz says that "during its entire course between the broad and the straight muscles of the abdomen it gives off *rami musculares* to them." Morris says, speaking of the nerve supply of the internal oblique, "The main branches of

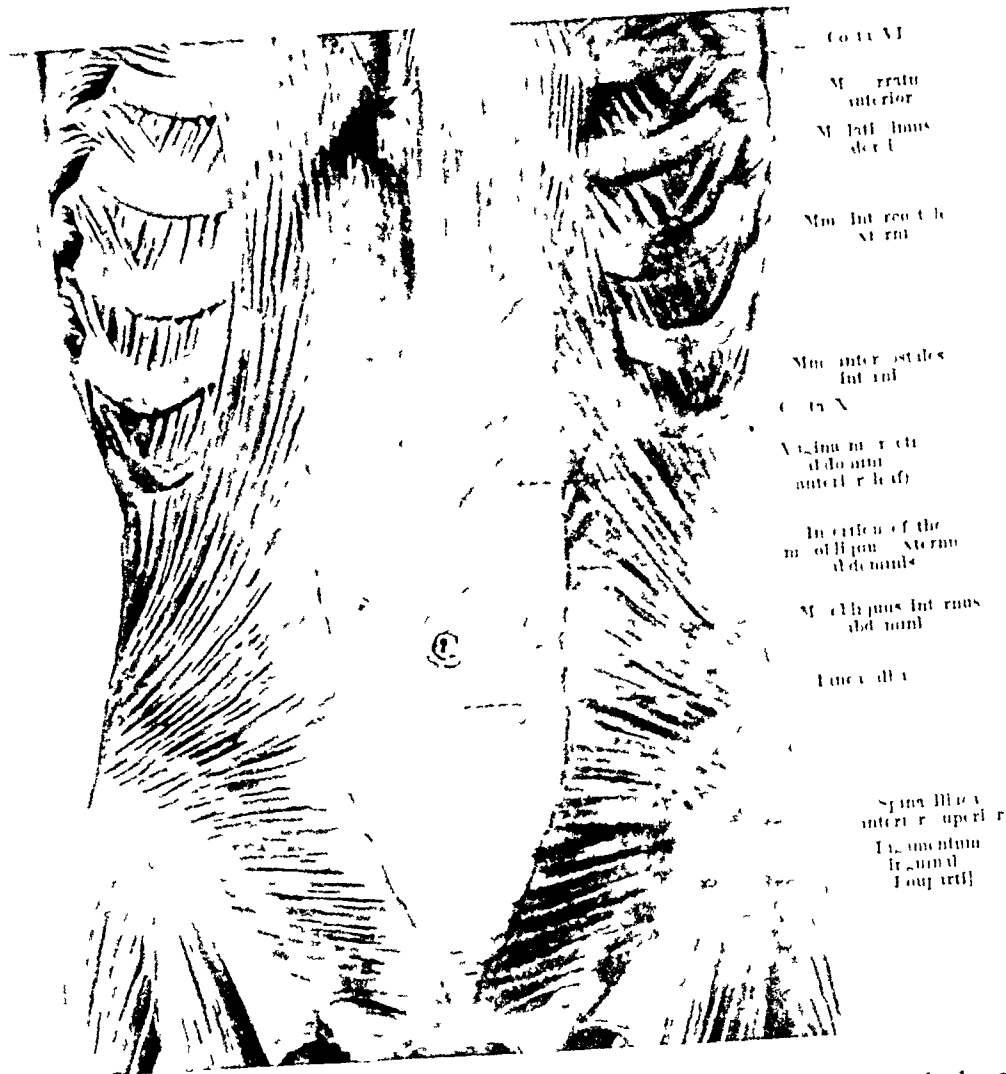


FIG. 10 —Plate from Spalteholz's Anatomy, showing the short transverse fibres at the lower part of the internal oblique muscle



these nerves run forwards between this muscle and the transversalis abdominis, and give off their filaments to the internal surface of the muscle, some also are distributed to the muscle by the branches which perforate it in order to supply the external oblique "

3 During hernia operations he had carefully inspected the nerve through a large lens, and, on lifting it up with the forceps, had seen little filaments branching from the nerve

4. He had cut out from the cadaver long strips of muscle in which the nerve lay and had dissected them out under dilute nitric acid solution on an illuminated stage and under a large lens, and had, in this way, seen similar nerve filaments branching from the main trunk of the nerve

5 He had had serial microscopic transverse sections made of the muscle strip containing the nerve, and in these sections had distinguished small nerve filaments which were distinct from the main trunk

6 He had stimulated this nerve by separating its distal portion and laying it over a piece of gauze, or a piece of rubber tissue, and, using a Faradic needle at the time of operation, had regularly obtained localized contractions of this part of the muscle

This series of reasons are so definite that he believed them to be much more valuable than experiments on the anterior roots of dogs

Men have walked on two legs for thousands of years and dogs have walked on four legs for a similar period, and hence have not had the same strain on the lower fibres of the abdominal muscles Degenerative changes in dogs' nerves are not as convincing as the facts which he had observed in men's muscles and nerves

Possibly Dr Moschcowitz and he were thinking of different things when they spoke of injury to this nerve during operation When he first called attention to the subject, he had recently gone through a period of several years with seven house surgeons, yearly, scattered through different institutions Their previous training had been diverse, and hence showed much about prevalent methods of hernia operation

The following methods of nerve injury may be noted (1) Forcibly scraping the internal oblique with scissors in clearing the way to Poupart's ligament, and tearing the nerve from its bed in so doing (2) Lifting the nerve from its bed with forceps and carrying it upward "out of harm's way" This, of course, tears away all the fibres which branch from it in this area (3) Splitting the external oblique aponeurosis from below, through the external ring, and dividing the nerve in so doing (4) Dividing it or including it in a suture just before its entrance into the external oblique aponeurosis.

The last is probably the least harmful of these procedures, because it injures the nerve beyond the place where most, or perhaps all, of the motor fibres have been given off But there is a trophic function beyond this point The trophic function exists in the sensory as well as in the motor parts of nerves It is believed to come from the sympathetic system, the fibres of which enter the nerve distal to the anterior nerve roots

## NEW YORK SURGICAL SOCIETY

An example of the trophic function in the motor part of nerves is shown when a cut of the median nerve in the palm or at the wrist is accompanied by trophic disturbance in the fingers, although the motor portion of the nerve which controls the fingers is not injured by this cut. Now this iliohypogastric nerve enters the aponeurosis of the internal oblique just above the external ring, and he was entirely willing to concede that at that point most of the fibres are sensory, but he was not at all willing to concede that they have lost their trophic function, and he thoroughly believed that a certain portion of the atrophic function affects the fibrous structures of the external oblique aponeurosis into which the nerve runs, and this aponeurosis is important in preventing direct hernia—a form which is most common in recurrences. Therefore, even the division or injury of the terminal part of the nerve at its entrance into the external oblique aponeurosis has a certain effect upon the strength of the structures which protect Hesselbach's triangle

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## A CLEAN AND COMFORTABLE METHOD OF TREATING ERYSIPELAS PATIENTS

BY SETH M. MILLIKEN, M D  
OF NEW YORK

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It is my belief that there is not any method of treatment for erysipelas that has proved to be curative. The following is suggested as making the patient most comfortable during the disease, thereby conserving his energies and perhaps hastening nature's cure.

*Method*—The patient is cleansed and put to bed. Rest is enforced during the acute fever and for two days after the temperature reaches and remains below one hundred. At the start calomel and salts are given and diet allowed according to the patient's appetite. Fluids are forced during the fever. Sedatives or stimulants are given if indicated by mental or circulatory symptoms.

Whenever ichthyol has been previously applied, as so frequently happens, it is removed as thoroughly as possible from so tender a surface. Then, if no wound demands local dressing, the entire region attacked by the disease is thickly dusted with powdered stearate of zinc which is reapplied as it falls or is brushed off. If a wound exists, it is treated as a similar wound would be treated in the absence of erysipelas. Thus, the face of a patient with abscess in the eyelids is powdered freely and the eyes kept moist with small compresses renewed from a basin of cold boric acid, a drop or two of 20 per cent argyrol is placed on the conjunctivæ from two to five times in twenty-four hours according to the local irritation evident. If in leg cases periphlebitis or cellulitis develops an incision is made as soon as fluctuation appears, and then wet dressings of boric acid or magnesium sulphate solution or dilute alcohol are applied.

This method was adopted as routine during my last service in the Bellevue Erysipelas Wards, November 16 to December 31, 1916, inclusive.

I would here like to thank my chief, Dr. Joseph B. Bissell, Director of the Fourth Surgical Division, for permission to use this method and report the results, as well as for various courtesies shown me heretofore.

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\* Read before New York Surgical Society, March 14, 1917



My first tests were in little babies with erysipelas, because I early noticed that, under the wet dressings of the adopted routine, the subsidence of the fever was often accompanied by alarming depression and subnormal temperature requiring stimulants and the application of heat.

In searching to avoid this, I found that Osler says "The inflamed region may be covered with salicylate of starch." As this material was not available the stearate of zinc was substituted with gratifying results.

During the last three periods of my Bellevue service, I have used the stearate dressing for all babies with erysipelas and for adults where the trunk was involved, and the results were so satisfactory that I decided to eliminate as far as possible all wet dressings and use the powder. The results were more satisfactory than any I had observed.

I believe this method has the following special advantages: first, the powder protects the inflamed area better than any other application and is fully as soothing. (It was especially noticed that where blebs were present they were better protected than under wet dressings which macerate and tear off the loose surface, and if the bleb broke the loose epithelium under the powder was not removed but remained to protect the sensitive base of the blister.) Second, the serum from blebs or other discharges does not make a hard scab with this dressing. Third, the patient's general comfort is tremendously increased, as the bed is not cold and sloppy, and the patient is relieved of the duty of renewing compresses. Fourth, under wet treatment in extremity cases there was frequent complaint of the hard crusty dressing when it became dry. This annoyance is obviated by the powder. Moreover, the nurses are able to give far more attention to the patient's comfort and condition, as no time is required to renew solution bowls, get ice, and change wet sheets, thus hospital supplies are conserved. Again, the Drug Department estimates that it is cheaper because no labor is required of them and container breakage is eliminated.

I have the temperature sheets of fifty-four cases treated in this service. The average duration of elevated temperature, that is above one hundred, was a small fraction under four days, the longest was twenty-one days. This was in a woman with the migratory form of the disease following an extensive suppuration of the tendon sheaths of the hand and forearm. The erysipelas progressed all over her body below the neck. The average duration of fever in the typical face cases, thirty-two in number, was a small fraction under three days. I would not at this time place too much importance on these figures as the virulence of erysipelas is well-known to run in waves, and, although in these patients the disease seemed to show average malignancy as judged, by the local conditions and the temperature reaction, it may well be that the infection was of less than average severity during the period of this service.

This method was continued by my successor in the Bellevue service.

and I hope later to report statistics of sufficient volume to be of real value

I have found no indications for internal medication in erysipelas, and Osler says there are none. In fact all the text-books I have consulted damn with faint praise the internal treatment which each seems to find it necessary to suggest.

Under local treatment, Osler says, "Of local applications ichthyol is at present much used. The inflamed region may be covered with salicylate of starch. Perhaps as good an application as any is cold water which was highly recommended by Hippocrates." The most recent publication that I have seen, which is Moorhead's "Traumatic Surgery," says, "Local measures have been recommended almost without number and cures often ascribed to them with about as much basis as if they had been similarly used to hasten the desquamation of scarlet fever, measles or any other disease of self-limited type." This agrees exactly with my opinion.

It may be well to mention some of the more or less well-known methods.

The vaccine method has not appealed to me and after Erdman's<sup>1</sup> experience at Bellevue I did not further try it.

Of local methods thought to act as cures I may mention the injection of antiseptics in front of the advancing margins.

I early learned that the streptococci advance irregularly ahead of the typical margin and in the few cases in which I saw it used the effect was ludicrous, the disease appearing beyond the injected area on schedule time. Sloughs due to the injection have been reported. One method that appealed to me theoretically and to which I gave a thorough trial was painting the involved area and a wide margin beyond with 95 per cent phenol later neutralized with alcohol. The successes were in no greater proportion than by palliative treatment and I stopped it after getting a superficial necrosis on the tip of the ear in one case and almost at the same time having a doctor, who had re-painted his mother's leg because my application had not checked the advance, report that she was voiding smoky urine containing casts and albumen. Once I saw a sort of lattice fence painted with 95 per cent phenol around the indurated margin. The erysipelas jumped the fence, roamed awhile and disappeared, leaving the fence to be erased by painstaking and pain-giving dressing. I have not used it myself. A somewhat similar method was painting a stripe or boundary board with iodine or silver nitrate about the inflamed area. To my eye it made a jarring color scheme and evidently increased the patient's subjective burning without affecting the course of the disease.

It seems to me that the most objectionable treatment and apparently the one most frequently employed, outside of hospitals, is be-

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<sup>1</sup> Jour A M A, December 6, 1913, p 2048

smearing the patient's inflamed area with grease containing some mixture of ichthyol. This causes neither subjective nor objective relief, is a dirty malodorous mess that firmly adheres to the tender skin and makes a nasty scab during desquamation, especially where hairy surfaces are involved. Other ointments vary from the above chiefly in color. They are objectionable because difficult and painful to remove.

In Bellevue and in most hospitals wet cold dressings had been adopted as routine treatment and were apparently somewhat alleviating. I object to aluminium acetate because it is disagreeably sour-smelling and frequently small pustules form under it which cause considerable itching and if confluent produce superficial ulcers. A saturated aqueous solution of picric acid has a very astringent effect on moist areas, but leaves a stain until desquamation is complete, or longer if it has been repeatedly applied.

Dilute alcohol 20 to 50 per cent applied on thick dressings and allowed to evaporate is very pleasant at first and slightly dehydrating. It is messy when wet and scratchy when dry, and if removed when dry pain is caused and a waffle-iron appearance conforming to the mesh of the gauze is left. As above stated, continuously renewed cold wet dressings were routine on the service. Usually boric acid solution was applied to the face, acetate to the extremities and ointment boric, not ichthyol, to the trunk.

My former routine was saturated solution of magnesium sulphate during the acute stage with fever, and no dressing during desquamation. This was used hoping that the magnesium sulphate had a slightly analgesic effect, but in these cases the powder was apparently just as soothing locally and certainly much neater and more comfortable generally.

I would like to add just a word on diagnosis.

It is usually stated that the lymph-nodes are enlarged in erysipelas. This does not agree with my observation, which is that the lymph-nodes are not enlarged unless suppuration is beginning, and I believe this sign is of great value in making the differential diagnosis between cellulitis and erysipelas, especially in leg cases where the symptoms are not as typical as in face cases. In doubtful cases I believe that we may say that it is not erysipelas if the femoral glands are enlarged.

# OBSERVATIONS ON THE NATURE OF POST-OPERATIVE LEUCOCYTOSIS IN THE DOG

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IN a previous work on the blood picture at various periods after splenectomy,<sup>1</sup> mention was made of the constant occurrence of a polymorphonuclear leucocytosis immediately after removal of the dog's spleen. This was considered to be different from the ordinary post-operative leucocytosis because of the fact that although the operation was done under complete aseptic precautions, it was practically bloodless and lasted only fifteen or twenty minutes, nevertheless the leucocyte count always passed 30,000 per cubic millimetre (an increase of over 200 per cent), and continued in a lesser degree above normal for several days or even two or more weeks. This comparatively long duration of the leucocytosis is even more striking in some human blood counts after removal of the spleen (Musser<sup>2</sup> and others). Since the above work was completed, however, leucocyte counts on dogs have shown that equally high figures may be obtained shortly after other aseptic operations. Furthermore, Dr. N M Percy<sup>3</sup> has found that a transient lymphocytosis occurs while the spleen is being removed for pernicious anæmia. It has therefore seemed advisable to study post-operative leucocytosis more intensively, and as the effect of etherization and of hemorrhage on the leucocyte count also has remained undecided, studies on these two features have also been included.

Numerous studies, dating mostly from fifteen or twenty years ago (White,<sup>4</sup> Da Costa and Kalteyer,<sup>5</sup> Cabot, Blake and Hubbard,<sup>6</sup> and others), have resulted in the establishment of fairly definite figures for the average height and duration of post-operative leucocytosis in man. Not only have such figures been wanting for the dog, however, but also it has seemed as if counts at more frequent intervals than has hitherto been attempted might throw more light on the mechanism involved.

*Method*—To this end, total leucocyte and differential counts have been made on 20 dogs, either normal or in the leucopænic stage of trypanosome anæmia, before and after ether narcosis, hemorrhage and various surgical operations. One or more counts having been taken previous to the experiment, in most cases subsequent counts were made every ten or fifteen minutes for the first hour, then hourly for the rest of the day, and finally every day or two until the count returned to normal. For the leucocyte counts, 2 square millimetres were counted

from drops from different parts of the Thoma pipette, according to the usual method, and for the differential count 200 to 500 leucocytes, stained by Wright's method, were examined. It is of course recognized that no significance can be attached to small changes that may be within the factor of error, and also that the individual response to a given procedure may vary greatly. The leucocytes were classified in the four customary groups (1) polymorphonuclear leucocytes, (2) small mononuclears or lymphocytes, (3) large and transitional mononuclears, and (4) eosinophiles (Mast cells occur rarely if ever in normal dog's blood). As will be noted later, various forms were found that varied from the typical description of these four classes, but for the

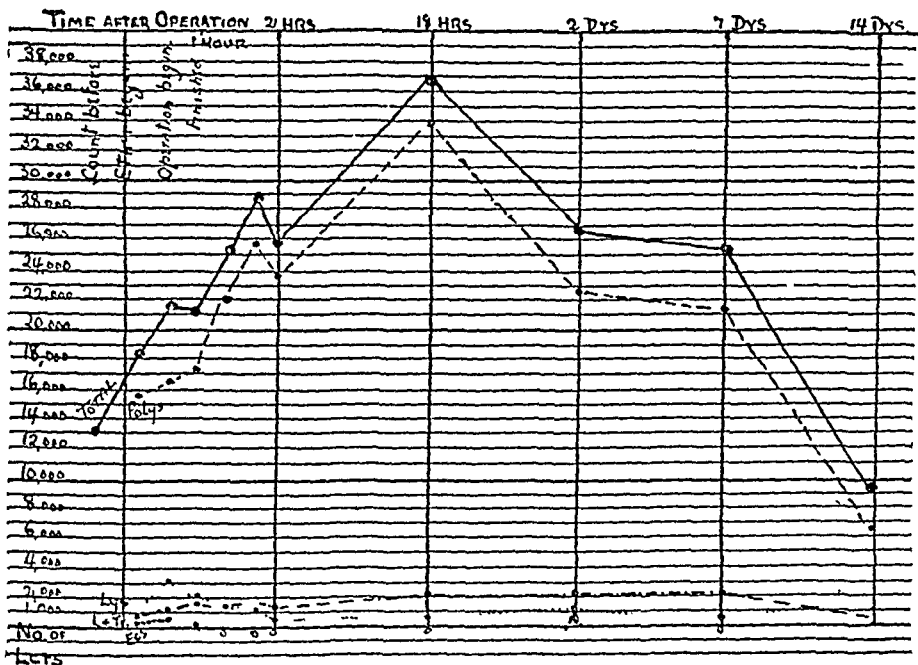


FIG 2—No 1719 Post-operative leucocytosis Bile duct-ureter anastomosis

sake of clarity in the charts these have not been given separate recognition

Most of the counts were made on dogs after removal of a kidney, spleen or eye, or after anastomosis of the common bile-duct with the ureter. Two experiments were on dogs etherized for an hour, using about 3 ounces of ether by intratracheal anæsthesia. Two other experiments were on dogs that had had 75 c c of blood withdrawn from the jugular vein in three minutes without anæsthesia, in one other this fresh blood was reinjected into the peritoneum, to simulate internal hemorrhage, and in another an accidental fatal internal hemorrhage occurred after nephrectomy from slipping of a ligature. In none of the dogs considered in this work were any signs of distemper or other acute infection visible. A temporary post-operative rise of temperature was of course present.

*Post-operative Results*—From the accompanying charts it will be



1



2



3



4



5



6



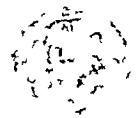
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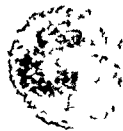
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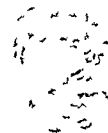
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FIG. 1.—Appearance of cells in post-operative blood smears from the dog 1, normal erythrocytes, 2 and 3, small lymphocytes, 4, basophilic lymphocyte (irritation form, Turk<sup>2</sup>), 5 and 6, young and adult polymorphonuclear leucocytes (Arnet<sup>3</sup>), 7 to 11, intermediate leucocytes, showing different grades between polymorphonuclear and transitional forms (form of nucleus, staining reaction of protoplasm), 12 to 14, transitional and large mononuclear cells, 15, eosinophilic leucocyte (note vacuoles and absence of definite eosinophilic granules). To increase ease of selection and reproduction, specimens were selected from two smears. Wright's stain. Zeiss, Homograph 1. Eye piece 4.



seen that the post-operative leucocytosis of splenectomy is essentially the same as that of other operations, so that the four post-operative charts may be considered together. Starting almost immediately after etherization (noted in one instance within three minutes of beginning etherization), a leucocytosis becomes evident, and after a slight pause (to be considered later) reaches a maximum in about eighteen hours. This great rise is almost entirely due to the polymorphonuclear elements, although the large and transitional group is also affected, especially in the latter half of the leucocytosis. Although the numerical changes in the latter group appear insignificant on the chart as compared with the extreme polymorphonuclear change, the figures in the ordinate column show that these forms have sometimes doubled or tripled in number. Furthermore, qualitative changes of two kinds are observed in the polymorphonuclear group. The nuclei of a distinctly greater number possess only one or two lobes (a shift of the Arneeth scale to the left), and in other cells (between 2 and 10 per cent in different animals at different times) the general appearance of the cell approaches to a greater or less degree that of the so-called transitional cell. This cell, which for the sake of convenience I have called an "intermediate" cell, is slightly larger, the protoplasm more opaque and without definite neutrophile granules and the nucleus of a more compact shape and taking a less brilliant purple stain. In fact, so many gradations of these changes (approaching the polymorphonuclear cell at one extreme and the transitional at the other) are sometimes found, that their proper classification in one or other of these groups becomes entirely arbitrary.

The small lymphocytes or small mononuclear cells, except for an early transient rise (which will be considered later), show practically no quantitative change. A qualitative change is noted, however, in that one of the subdivisions of this group is represented more frequently. In the normal differential count of dog's blood, a few of the lymphocytes (two or three per cent), when stained by Wright's method, show a protoplasm of Prussian blue, resembling Turk's irritation forms, and are considerably larger than the ordinary small lymphocyte. These are often increased to 10 or more per cent of the small mononuclear group after operation. As the reaction of these and the "intermediate" cells to other stains has not been investigated, no attempt can be made to determine their true position in the leucocyte family. Attention should be called, however, to their appearance in the blood stream after operation.

The eosinophiles, as has been noted in human post-operative leucocytosis, are either diminished or in many cases disappear entirely from the peripheral blood for many hours after operation.

The leucocytosis following splenectomy differs only from other post-operative leucocytoses in that it tends to last longer. Thus in



Fig 3 it will be seen that the leucocyte count is still above normal when the last count was made eight days after operation. In Fig 4 the quicker return to normal is probably to be accounted for by the youth of the animal. The longer duration of the leucocytosis is in accord with Bernheim, King and Jones' recent observations that the rise in the count of the various blood-corpuscles after blood transfusion is longer maintained in splenectomized than in normal animals.

Opportunity was offered by coincident work in this laboratory on trypanosome anaemia in dogs to study as well the leucocytic response to operation of leucopænic animals. For several weeks after infection,

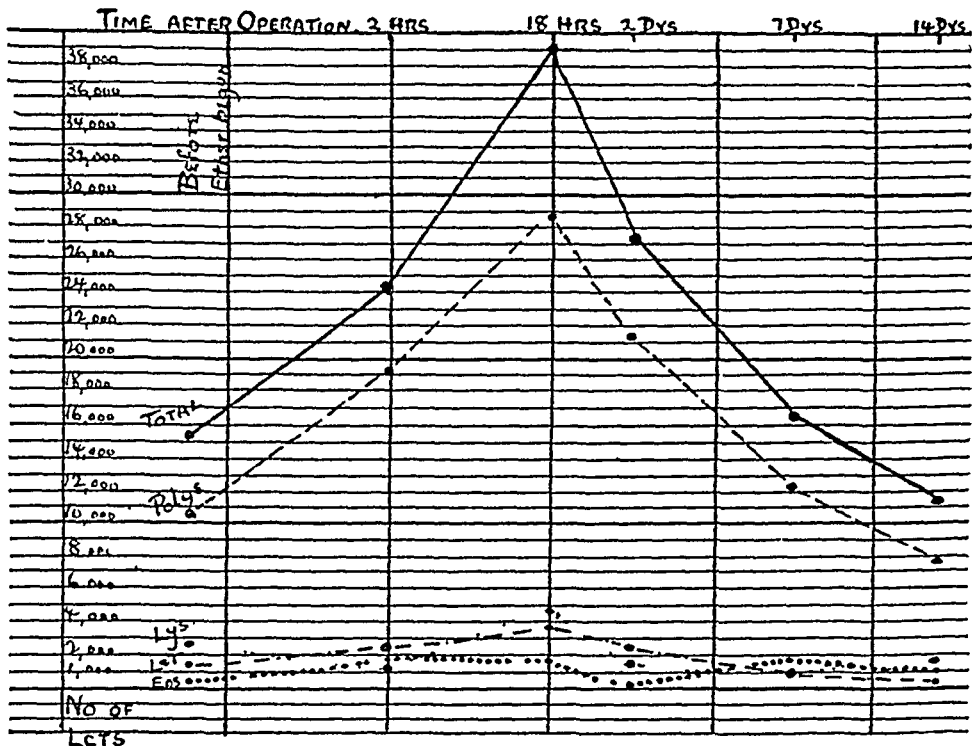


FIG 3—No 1671 Post-operative leucocytosis Bile-duct-ureter anastomosis

*T. equiperdum* causes a progressive leucopænia, reaching as low as 5000 or 6000 cubic per millimetre. When dogs are operated upon at this stage, whether for splenectomy (1669) or other surgical procedures, such as removal of an eye (1693), a post-operative leucocytosis of the same nature as in normal dogs occurs. It often fails, however, to attain as high a level, and may take three or four days to reach its maximum. As the bone marrows of these animals are definitely hyperplastic (chiefly leucoblastic), this delayed response, like the Arneith shift to the left and the appearance of intermediate cells, would indicate that post-operative rise is chiefly, at least, due to the summoning of new leucocytes from the bone marrow, which in the leucopænic trypanosome dogs cannot be so well or so quickly supplied.

*Narcosis*—Charts of the two dogs etherized for one hour show that a definite leucocytosis is produced, and that it characteristically

## NATURE OF POST-OPERATIVE LEUCOCYTOSIS

exhibits two distinct phases These may be considered as inversely analogous to the proto- and deutero-phases of benzol leucopænia,

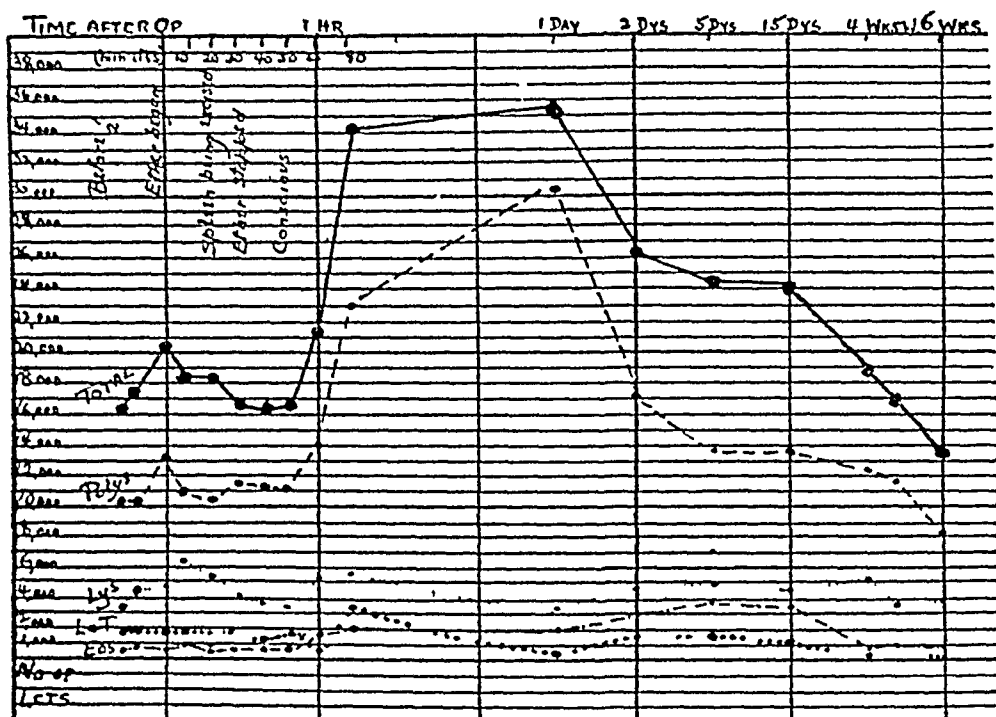


FIG 4 — No 17 03 Post-operative leucocytosis Splenectomy

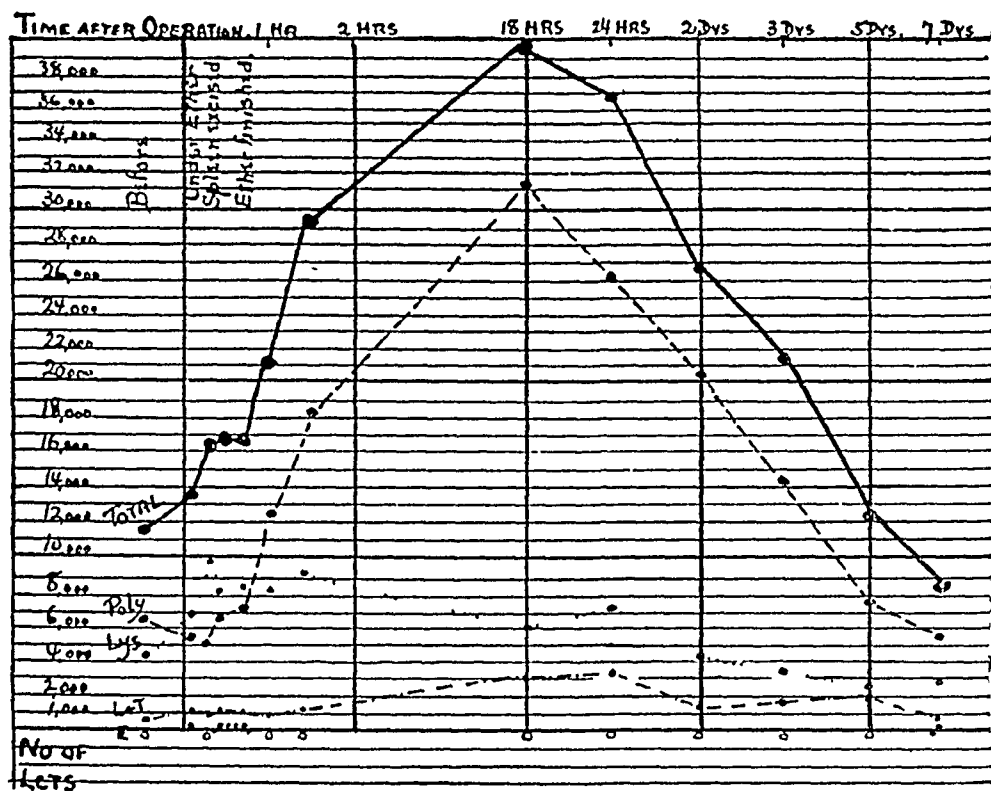


FIG 5 — No 17 07 Post-operative leucocytosis Splenectomy

described by Weiskotten, Schwartz and Steensland<sup>8</sup> The first rise, which reaches its maximum in the first half-hour and may already

disappear before the end of the hour's etherization, is due to an increase in small mononuclears as well as in the polymorphonuclear cells. Its influence can be observed in those post-operative charts in which a sufficient number of early counts were made, as the small peak occurring in the first hour after operation, before the larger and later rise. The second phase is due almost entirely to polymorphonuclear cells, and like the post-operative rise shows to a less degree an increase in transitional cells, a slight shift to the left of the Arneth scale, and the appearance in small numbers of the "intermediate" cells previously described. In the post-operative charts it is buried in the greater post-operative rise.

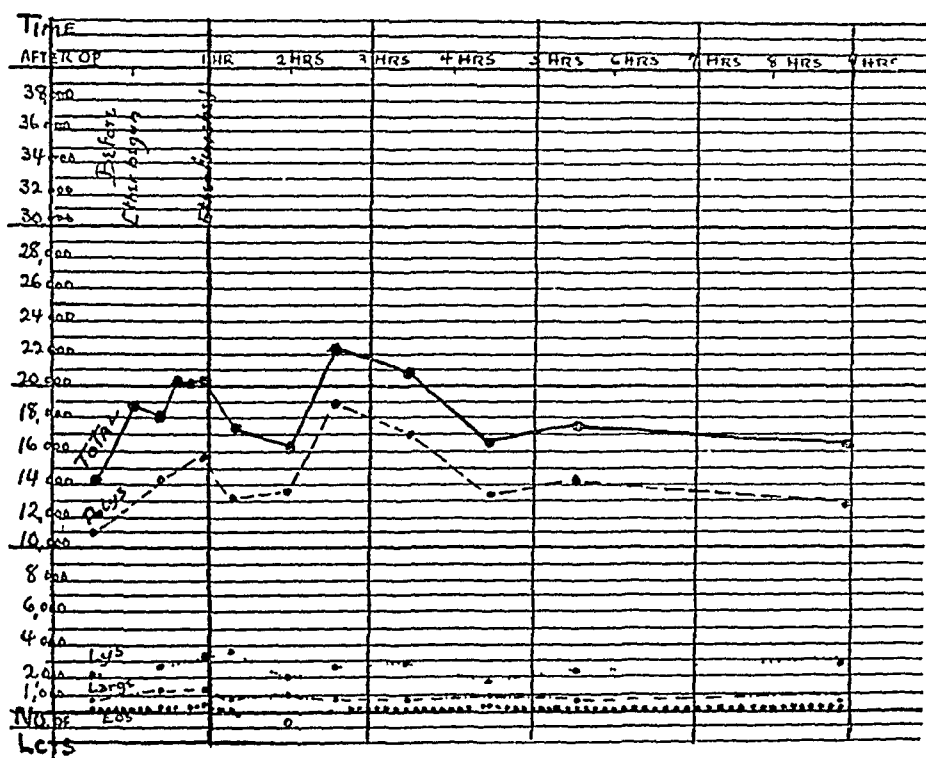
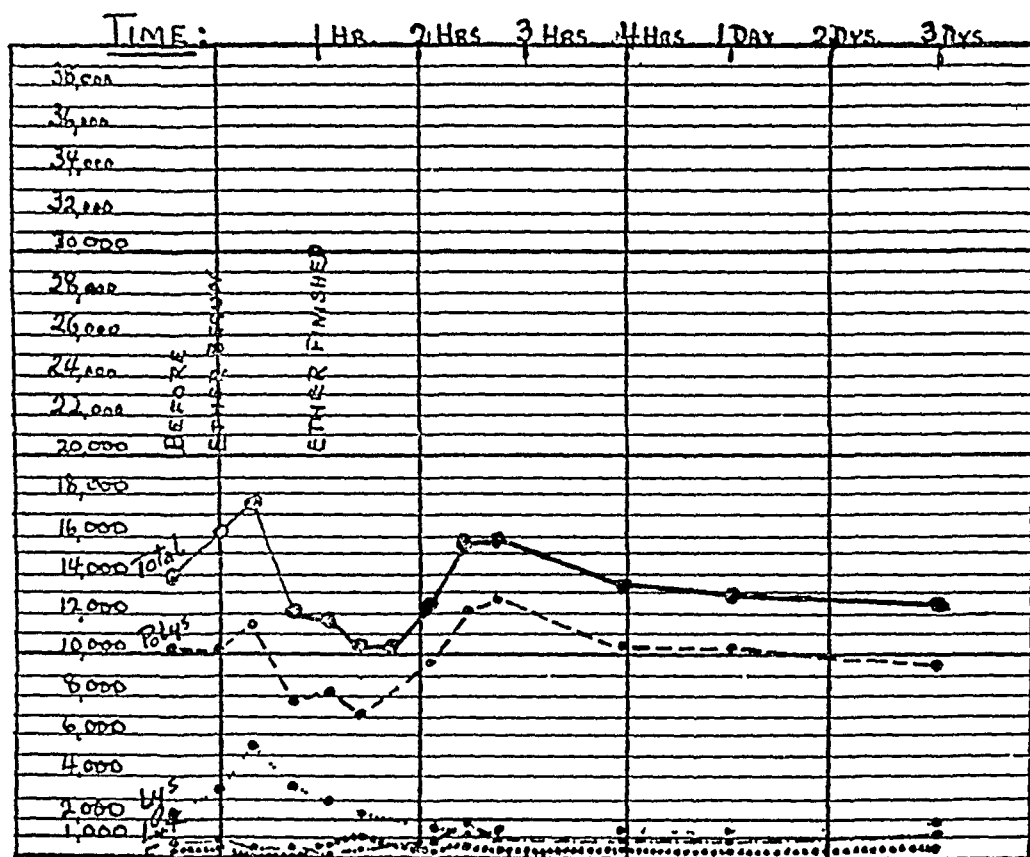


FIG 6—No 17 30 Narcosis leucocytosis Ether one hour

**Hemorrhage**—The leucocytosis that occurs after the withdrawal of 75 to 100 cc from the jugular vein of a medium-sized dog (10 kilos) is definite, but of different character from those previously described. Except for slight initial fluctuations, the count remains unchanged for several hours. As post-hemorrhagic hydræmia was not controlled, it is possible that an earlier rise could have been masked by such a factor. The red cell count in the two dogs examined was only slightly reduced (less than 1 million per cubic millimetre) for the first hour and then remained normal throughout the experiments. The leucocyte count begins to rise after four or five hours, almost doubling in the first thirty hours, and gradually declines to normal during several days. In one dog the rise was due entirely to poly-

## NATURE OF POST-OPERATIVE LEUCOCYTOSIS

morphonuclears, in the other both polymorphonuclears and small mononuclears were increased. In a third experiment (No 17.34) an equivalent amount of blood (100 c c) was withdrawn from the jugular vein during a period of five minutes. As fast as it was withdrawn it was reinjected into the same dog's peritoneal cavity, thus attempting to simulate the conditions of an internal hemorrhage. One needle was left in the jugular vein during the transference and another in the peritoneal cavity. The whole fresh blood was transferred by the alternating use of 20 c c. syringes, without defibrinating. As



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FIG 7—No 17 28 Narcosis leucocytosis Ether one hour

Sweet<sup>9</sup> has recently shown that fresh blood in the peritoneal cavity is rapidly taken up in large quantities by the thoracic duct and thus reintroduced into the circulation, it was thought that the stimulus to leucocytosis caused by the loss of blood from the body might thus be overcome. It will be seen that there was no noteworthy change for eight hours, and then only two counts (at twenty and thirty hours) showed a rise in leucocytes, similar to those previously described. It is of course impossible to know whether any of the injected blood underwent coagulation. Such coagulation would not only impede reabsorption but on disintegrating would afford more than sufficient stimulus for the late rise that was noted. It will also be noticed that

an extreme leucocytosis, such as Dold<sup>10</sup> considers of value in the diagnosis of internal hemorrhage, was not found in this dog. In another animal (1735), whose leucocytes were being followed after removal of a kidney, a fatal internal hemorrhage followed slipping of a ligature. Although the final count was made as the animal was dying, the leucocyte counts maintained an almost constant level, showing on the one hand that copious hemorrhage may continue for at least five hours without leucocytosis, but on the other hand, that the leucocyte count, unlike the red cell count, may be maintained until the moment of death.

*Summary*—Splenectomy, like other aseptic operations, causes in the dog a marked leucocytosis that reaches its maximum in about 18 hours. In normal dogs the highest count, if frequent enough counts

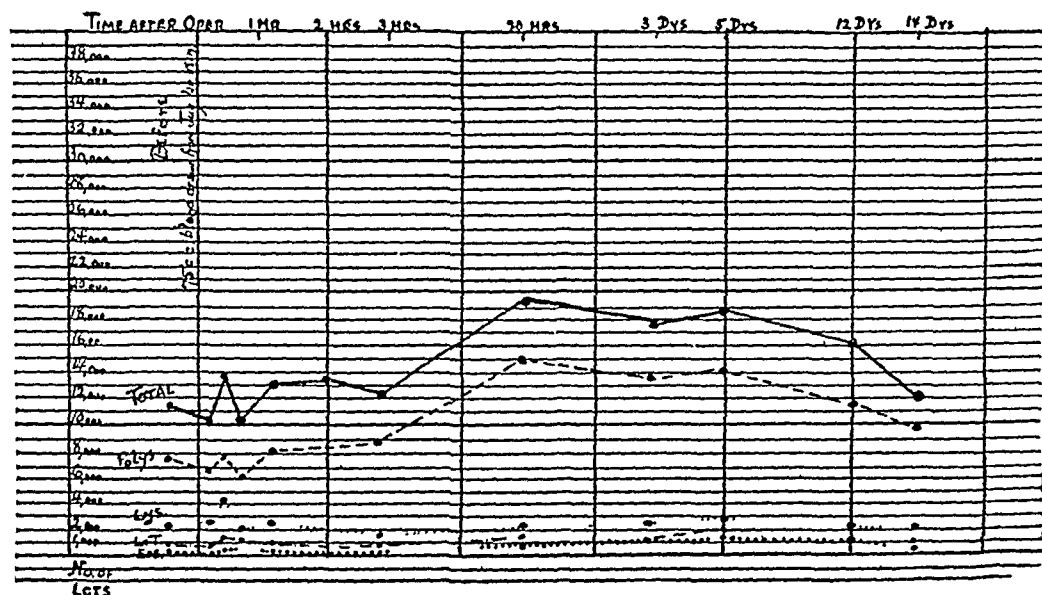


FIG 8—No 1727 Post-hemorrhagic leucocytosis 75 c c bled from jugular vein

are made, is always over 30,000 and usually over 40,000 per cubic millimetre. Post-operative leucocytosis in dogs lasts from four to seven days, but post-splenectomy leucocytosis is usually more protracted.

The leucocytosis is almost entirely due to the polymorphonuclear leucocytes. The proportion of younger forms is increased (Arneth shift to the left) and "intermediate" forms appear, that partake of some of the characteristics of so-called transitional cells. The later group is increased and eosinophiles are diminished or disappear from the peripheral blood.

In dogs in the leucopænic stage of trypanosome anæmia, surgical operation does not cause such an extreme leucocytosis and it may take several days instead of hours to reach its maximum.

## NATURE OF POST-OPERATIVE LEUCOCYTOSIS

Uncomplicated narcosis (ether) produces a rise of from 3 to 10,000, occurring characteristically in two phases. The first of these phases reaches its maximum in fifteen to sixty minutes and is due to

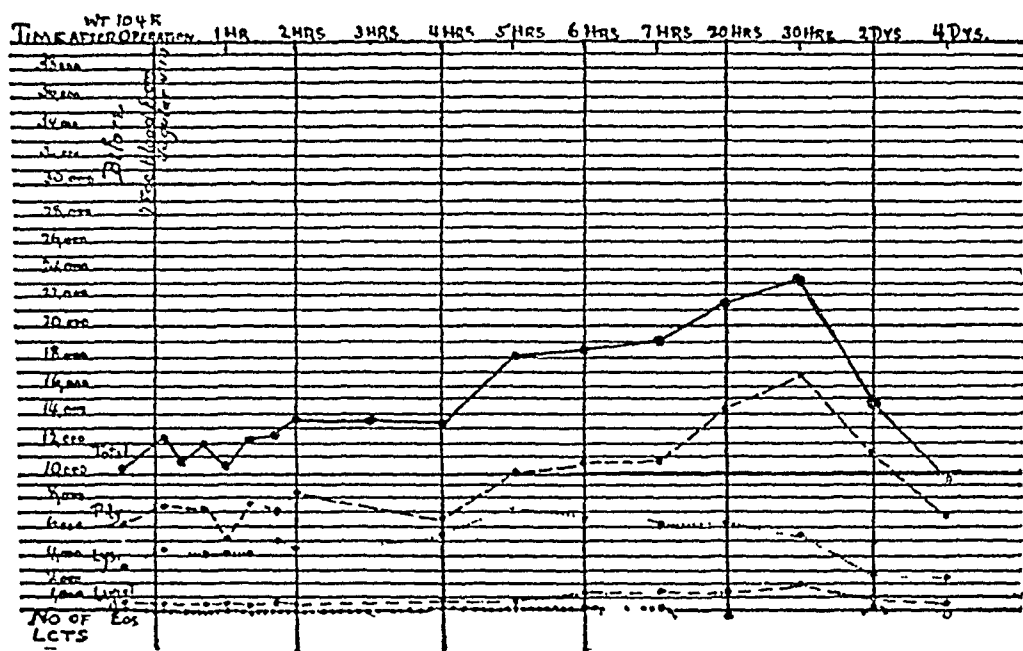


FIG 9—No 17 29 Post-hemorrhagic leucocytosis 75 c c bled from jugular vein. Red blood-cell was lowered less than 1 million in the one-hour count, was normal from two-hour on

an increase both in the polymorphonuclear and small mononuclear elements. The second rise usually begins in about two hours and is practically finished in another two hours. The first of these is prob-

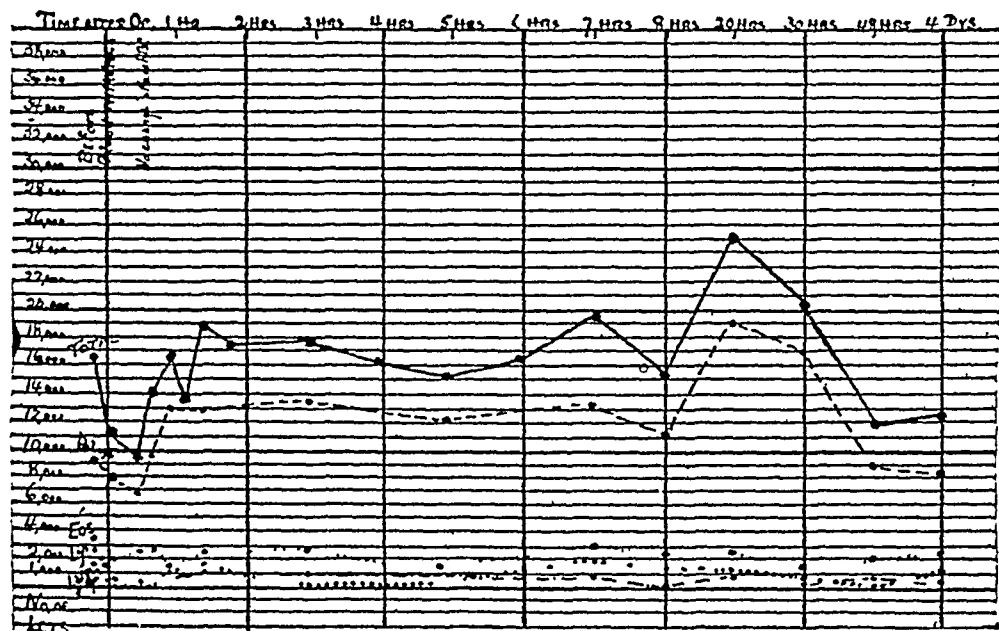


FIG 10—No 17 34 Post-hemorrhagic leucocytosis Internal 100 c c from jugular vein, reinjected intraperitoneally

ably due to a direct irritant effect of the ether (positively chemotactic to the lymphocytes), the second to a summoning of new polymorphonuclears from the bone-marrow, as in post-operative leucocytosis.

Hemorrhage of moderate amount causes a leucocytosis of 100 per cent or more, that typically does not become apparent for four or five hours, reaches its maximum in the first twenty-four hours, but may take more than a week before it returns to normal. These changes are more marked in external than in internal (intraperitoneal) hemorrhage of equal amounts of blood. In one animal an internal hemorrhage that proved fatal in five hours failed to cause any noteworthy change in the leucocyte count up to a few minutes before death. It is difficult to understand why withdrawal of an amount of blood, insufficient to cause more than a fleeting disturbance in the red blood count, and in the absence of ether or operative disturbance, should cause a distinct leucocytosis lasting several days. As such occurs, however, a bone-marrow stimulant must be sought.

#### CONCLUSIONS

1 In dogs, the leucocytosis that followed splenectomy only differs from other post-operative leucocytoses in the somewhat slower return to normal.

2 Post-operative leucocytosis, and the lesser degrees of leucocytosis that follow narcosis and hemorrhage, are chiefly due to the summoning of new and younger forms of polymorphonuclear cells from the bone-marrow into the peripheral blood stream.

3 The appearance of "intermediate" forms in the blood stream after operation suggests that a relationship exists between the polymorphonuclear leucocyte and so-called transitional cells.

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# THE VALUE OF THE LEUCOCYTE COUNT IN THE DIAGNOSIS AND PROGNOSIS OF ACUTE APPENDICITIS, AS BASED ON EXPERIENCE IN ONE HUNDRED CASES

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THE value of the leucocyte count in the diagnosis of acute inflammatory diseases is now well recognized. It is necessary, however, with all laboratory work to correlate the laboratory results with the findings obtained at the bedside. This dictum is as true in the consideration of the relation existing between the behavior of the leucocytes in acute appendicitis as it is in any other acute surgical disease. As DaCosta<sup>1</sup> has stated "The surgeon who attempts to use the blood count in appendicitis as a definite pathognomonic sign will soon run afoul of diagnostic disasters, but he who regards it only as a symptom invariably to be correlated with equally if not more important clinical manifestations, cannot fail to find this method of inquiry of signal value in routine clinical surgery."

The counts here submitted have all been taken from cases of appendicitis clinically acute, and in so far as we have been able to ascertain, no coexistent infection has been present. All counts were taken within a few hours of operation and the great majority were taken immediately before the administration of the anæsthetic. In some instances several counts were made, but only the counts taken immediately before operation have been included in this series. The age of the patients ranged from fifteen to fifty-eight. The wide variation noticeable in the counts reveals the widely variant acuteness of the infection and the effort exerted by the resisting forces of the body.

An attempt has been made to classify these cases into simple groups, based upon the pathological condition found at operation, but, because of the diversity of the pathological processes, any simple classification upon such a basis was found impossible. For the purpose of convenience, however, the cases have been arranged in the following groups:

Group 1. Infection confined to the appendix. This group includes catarrhal cases, and all cases in which, on clinical evidence only, infection had not extended beyond the appendix.

Group 2. Appendix perforated, infection circumscribed, including gangrenous appendices and all cases where the infection had been delimited.

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<sup>1</sup>Quoted by Fowler "The Relation of the Lesion in Appendicitis to the Leucocyte Count." *Surgery, Gynecology and Obstetrics*, 1908, vii, 308



Group 3 Appendix ruptured, with infection unencircled, including all degrees of peritonitis from the very early type up to that of general peritonitis

In the first division are classed 35 cases and the counts are here appended

	Total White	Poly Per Cent	Small Per Cent	Large	Trans	Eosin	Results
1	8,880	89	45	65			Recovery
2	15,200	77.5	11.4	45	5	1	Recovery
3	20,750	80	14	5	1		Recovery
4	16,000	72	19	8	1		Recovery
5	19,000	82.5	12.5	5			Recovery
6	11,560	85.5	5	4	5	5	Recovery
7	11,040	91	5	35	5		Recovery
8	19,800	88	8.5	3	5		Recovery
9	17,000	85	6	8	1		Recovery
10	17,800	80.5	12.5	18.25			Recovery
11	42,000	93	3	2	2		Recovery
12	8,735	67.5	22.5	2	8		Recovery
13	11,600	93.5	2	35	1		Recovery
14	9,600	78	13	4	2	3	Recovery
15	17,600	72	16	10	2		Recovery
16	21,700	71	8	14	1	6	Recovery
17	8,300	87	8	3		2	Recovery
18	25,200	92.5	4.5	3			Recovery
19	12,800	82	11	7			Recovery
20	20,000	83	8	4	5		Recovery
21	29,200	91.5	6.5	1	1		Recovery
22	10,500	79	12	8	1		Recovery
23	13,400	71	23	1	5		Recovery
24	21,966	80.5	8.5	1	9	1	Recovery
25	14,200	80	14	4	1	1	Recovery
26	12,680	83	12	3	2		Recovery
27	8,080	72	20	8			Recovery
28	30,000	91	6	3			Recovery
29	20,400	80	12		8		Recovery
30	8,800	86	13	1			Recovery
31	10,800	74.5	23.5	1		1	Recovery
32	9,840	85	4.5	10	5	4	Recovery
33	6,200	50.5	30	19.5			Recovery
34	19,200	73	13	8.5	15	4	Recovery
35	33,000	80	16	4			Recovery

It will be noted that the absolute counts range from 6200 to 42,000, and that the differential counts range from 50.5 to 93.5. All of these cases were clinically acute.

Case 33 (absolute 6200 with 50.5 per cent polynuclear) was considered acute previous to the operation. At operation, however, no evidence of an acute process could be found. The acuteness of the symptoms was evidently due to a kink of the appendix caused by an adventitious (Jackson's) membrane. This count has been included in this series to emphasize the fact that a simple mechanical condition may produce clinical evidence sufficient to justify a diagnosis of acute

## LEUCOCYTE COUNT IN APPENDICITIS

appendicitis in the absence of leucocytosis, either absolute or differential

The next low count, case 12 (absolute 8735 with 67.5 per cent polynuclear), was taken in a case clinically acute. At operation, however, no pathological process could be detected macroscopically, but it is highly probable that histological examination of this particular appendix would have revealed evidence of an acute inflammatory process.

Cases 4, 15, 23, 27 and 34 were of the catarrhal type. Case 16 (absolute 21,700 with 71 polynuclear) was an extremely acute case in a girl of sixteen and it is difficult to discover a reason why the polynuclear count should have been so low. This would tend to emphasize the fact that a differential count may not always be *per se* of diagnostic importance.

Case 7 (absolute 11,040 with 91 per cent polynuclear) was another acute case similar in many respects to case number 16. The patient was a girl of fifteen. In comparing case 7 with case 16 it may be stated that both appendices were distended with pus, that the pathological condition was similar in each instance, that these patients were young and vigorous, and in so far as one could determine, both should have possessed equal resistance to the infection. The conviction again forced upon one is that no two patients resist infection in the same manner, and further, that the count in each case should be applied as evidence to that particular case only.

Another observation is quite pertinent (Case 1 absolute 8080, polynuclear 89 per cent; Case 17 absolute 8300, polynuclear 87 per cent; Case 30 absolute 8800, polynuclear 86 per cent). In these cases, had absolute counts alone been made, the only conclusion possible would have been that no infection existed. When the differential counts are taken into consideration the conclusion is justified that infection was certainly present. These three cases were extremely acute types, in one case the appendix showed one small spot of gangrene.

In summing up the counts in group 1, the following data may be recorded. Lowest absolute count, 6200, highest absolute count, 42,000, lowest polynuclear count, 50.5 per cent, highest polynuclear count, 93.5 per cent, average absolute count, 16,652, average polynuclear count, 81 per cent.

Passing to the next group we note first, that both the absolute and the polynuclear counts are generally higher, and also that the largest number of cases are classed in this group.

	Total White	Poly Per Cent	Small Per Cent	Large	Trans	Eosin	Results
36	29,200	87	7	6			Recovery, gangrenous with large enterolith
37	33,800	73	12	15			Death, post-operative ileus
38	10,600	93	7				Recovery
39	25,600	82	18				Recovery
40	7,800	65	2	31		2	Recovery
	10						

# HERBERT W HEWITT

	Total White	Poly Per Cent	Small Per Cent	Large	Trans	Eosin	Results
41	7,600	80	14 5	5		5	Death, embolism, gangrenous appendix
42	5,500	79	12	8	1		Recovery, gangrenous appendix
43	15,375	78	20	1	5	5	Recovery, gangrenous appendix
44	20,000	83	16	5	5		Recovery
45	12,900	84	13	3			Recovery
46	12,620	84	12	4			Recovery
47	25,400	89	10 5	5			Recovery
48	10,400	89	10		1		Recovery
49	18,800	85	5	10			Recovery
50	32,400	92 5	2 5	2 5	2 5		Recovery
51	23,000	91 5	5	3 5			Recovery
52	29,400	91	6	3			Recovery
53	29,800	91	3 5	5 5			Recovery
54	13,733	86	9	5			Death, post-operative hemorrhage
55	13,200	78	7	13	2		Recovery
56	14,080	72	16 5	10 5	1		Recovery
57	35,160	89 5	5	4	1 5		Recovery
58	13,840	77 5	12 5	8	1	1	Recovery
59	21,000	94	2	4			Recovery
60	6,200	84	13 5	2	5		Recovery
61	38,000	85 5	4 5	10			Recovery
62	17,900	93	4 5	2 5			Recovery
63	20,300	87 5	8 5	4			Recovery
64	15,375	78	1	20 5	5		Recovery, gangrenous
65	14,200	78	19	1 5	5	1	Recovery
66	18,800	85	9	4	1	1	Recovery
67	15,400	86	2	12			Recovery
68	24,300	80 5	9	9 5	5	5	Recovery
69	36,200	97	1	2			Recovery
70	28,500	92	4	2	2		Recovery
71	13,600	79	19	.	2		Death, post-operative pneumonia
72	13,500	88	12				Recovery
73	11,200	83	13	4			Recovery
74	20,000	80	18	2			Recovery
75	32,800	95	4	1			Recovery
76	23,200	80	19	1			Recovery
77	16,300	90	10				Recovery
78	23,000	93	7				Recovery
79	18,000	89	11		.		Recovery
80	12,320	83 2	8 6	8	2		

*Comment*—Case 40 (absolute 7800, polynuclear 65 per cent ) was a well circumscribed abscess existing for a good many days, hence the low count

Case 37 (absolute 33,800 with polynuclear 73 per cent ), if one could judge by the count, one would say that the prognosis was especially favorable This case was of the perforative type with limiting

adhesions There was tympanites at the time of the operation, probably due to a localized peritonitis, although in so far as could be determined at the operation, the infection was circumscribed The appendix was removed and the wound drained, but patient died on the sixth day from post-operative ileus It might be stated that this was a neglected case, neglected not through any fault of the attending physician or surgeon, but because of the antagonistic attitude of the patient toward surgical intervention Operation was performed on the fifth day following the initial symptoms, the condition was clinically serious at the time of operation

Case 41 (absolute 7600 with polynuclear 80 per cent) was acute with free pus, operation drainage only The patient died suddenly on the second day, probably from embolism, although no autopsy was permitted

The remainder were good or bad operative risks, or intermediate between these two extremes, the counts indicating quite accurately not only the condition found at the time of the operation, but also gave a definite idea of the patients' resistance to the infection, or, in other words, a definite idea of the prognosis

Summing up Group two, the following data may be recorded Lowest absolute count in Group two, 5500, highest absolute count in Group two, 38,000, lowest polynuclear count in Group two, 65, highest polynuclear count in Group two, 97, average polynuclear count in Group two, 87.3, average absolute count in Group two, 17,517

Thus, it will be observed, that both the average absolute and the average polynuclear counts are higher than in Group one, the average polynuclear count being considerably higher

Passing on to Group three, we find twenty cases with four deaths

	Total White	Poly Per Cent	Small Per Cent	Large	Trans	Eosin	Results
81	17,800	89	6.5	1.5	3		Recovery
82	18,000	86	11	3			Recovery
83	9,600	92	5	3			Death, general peritonitis
84	25,400	79	15.5	5.5			Recovery
85	35,800	92	5	3			Recovery
86	18,600	93	6	1			Recovery
87	22,100	91.75	1.75	6.5			Recovery
88	28,500	92	5	3			Recovery
89	32,400	92.5	2.5	2.5	2.5		Recovery
90	7,600	92	8				Death, general peritonitis
91	20,800	90.5	5	4.5			Death, post-operative hemorrhage
92	23,200	89.5	3.5	7			Death, embolism
93	16,640	84	9	7			Recovery
94	22,000	88	12				Recovery
95	19,000	89	11				Recovery
96	15,200	89	7	2	2		Recovery
97	19,400	94	6				Recovery
98	6,700	85	11	4			Recovery
99	14,288	93.5	2.5	1	5	Deg 2.5	Recovery
100	28,431	90.5	5	4.5			Recovery

*Comment*—Case 83 (absolute 9600, polynuclear 92) this leucocyte count may be interpreted as indicating a severe infection with poor resistance, which was true (tympanites, localized peritonitis, etc )

Case 91 diagnosis, general peritonitis, although all that was done for this patient was merely a drainage operation, an uncontrollable hemorrhage began the night following operation I was called in the night about twelve hours after operation and sent the patient immediately to the operating room We were able to obtain a donor on short notice and the patient was transfused with blood, but he was very weak, and did not survive It was disclosed to us afterwards that this patient was a hæmophilic

Case 92 was also one of general peritonitis The operation consisted of drainage only, with one incision over the appendix region and a second incision just above the pubis The patient did famously until the evening of the tenth day, when he died very suddenly, probably from embolism, although no autopsy was allowed

Case 90 was one of general peritonitis (absolute 7600, polynuclear 92) The leucocyte count gave a clue to her low resisting power Drainage only was done, followed by Murphy treatment for peritonitis, but in spite of all our efforts the patient succumbed on the seventh day

When we consider that we lost only four cases in twenty of general peritonitis, the results are certainly an improvement over former statistics

With the exception of cases 98 (absolute 6700, polynuclear 85) and 84 (absolute 25,400, polynuclear 79) the polynuclear count in this group ranges rather close to the ninety mark, one of 84 per cent, one of 85 per cent, one of 86 per cent, one of 88 per cent, three of 89 per cent and one of 89.5 per cent, eight in all being below ninety and three only below eighty-eight So it would seem if we are in any doubt regarding our diagnosis that a positive blood count (85 per cent or more polynuclear) when taken in conjunction with the clinical manifestations of acute appendicitis would practically always clinch the diagnosis

Summing up Group three, the following data may be recorded Lowest absolute count, 6700, highest absolute count 35,800, lowest polynuclear count, 79 per cent, highest polynuclear count, 94 per cent, average polynuclear count, 89.5 per cent, average absolute count, 20,072

Comparing these figures with Group two, we note that the average polynuclear count is higher, 89.5 to 87.3, and that the average absolute count is also higher, 20,072 to 17,517

A summary of the whole series gives the following data Lowest absolute count, 5500, highest absolute count, 42,000, lowest polynuclear count, 50.5 per cent, highest polynuclear count, 97 per cent, average absolute count, 18,080, average polynuclear count, 85.9 per cent

## LEUCOCYTE COUNT IN APPENDICITIS

Further observations Case 12, 8735, 67.5, case 27, 8080, 72, case 33, 6200, 50.5, case 40, 7800, 65. These are practically normal counts, and the only assistance obtained from them was that the infection, if one was present, was confined entirely to the appendix and this proved true.

Consider again cases 1, 8080, 89 per cent, 17, 8300, 87, 30, 8800, 86, 32, 9840, 85, 42, 5500, 79, 48, 10,400, 89, 60, 6200, 84, 83, 9600, 92, 90, 7600, 92, 98, 6700, 85.

The absolute count would hardly justify the conclusion that an infection was present, yet all were serious cases, two, in fact, died. So it seems reasonable to infer that a low absolute count with a high polynuclear count should always be looked upon as indicative of a serious lesion. The reader's attention is now directed to the following groups.

*Group A*—Cases 2, 15,200, 77.5, 3, 20,750, 80, 15, 17,600, 72, 24, 21,966, 80.5, 29, 20,400, 80, 34, 19,200, 73, 35, 33,000, 80, 68, 24,300, 80.5, 74, 20,000, 80, 76, 23,200, 80, 84, 25,400, 79. These cases were all good risks, both clinically and hæmatologically, and all recovered.

*Group B*—Cases 8, absolute 19,800, polynuclear 88 per cent, 18, absolute 25,200, polynuclear 92.5, 21, absolute 29,200, polynuclear 91.5, 28, absolute 30,000, polynuclear, 91, 36, 29,200, polynuclear 87, 39, absolute 25,600, polynuclear 82, 44, absolute 20,000, polynuclear, 83, 47, absolute 25,400, polynuclear, 89, 51, absolute 23,000, polynuclear 91.5, 57, absolute 35,200, polynuclear, 89.5, 59, absolute 21,000, polynuclear 94, 63, absolute 20,300, polynuclear 87.5, 78, absolute 23,000, polynuclear 93, 87, absolute 22,100, polynuclear 91.75, 94, absolute 22,000, polynuclear 88, 97, absolute 19,400, polynuclear 94.

It will be noted that in this grouping we have a high absolute count associated with a high polynuclear count. These cases were more serious than those of the previous group, yet all recovered.

*Group C*—Case No 11, absolute 42,000, polynuclear 93, No 28, absolute 30,000, polynuclear 91, No 50, absolute 32,400, polynuclear 92.5, No 52, absolute 29,400, polynuclear 91, No 53, absolute 29,800, polynuclear 91, No 57, absolute 35,160, polynuclear 89.5, No 61, absolute 38,000, polynuclear 85.5, No 69, absolute 36,200, polynuclear 97, No 70, absolute 28,500, polynuclear 92, No 75, absolute 32,800, polynuclear 95, No 85, absolute 35,800, polynuclear 92, No 89, absolute 32,400, polynuclear 92.5, No 100, absolute 28,431, polynuclear 90.5.

All reveal a very high absolute count as well as a high polynuclear count, showing that a high polynuclear count per se does not always indicate a bad prognosis. Case No 11 (absolute 42,000, with polynuclear 93 per cent) recovered without a bad symptom, as did also Case No 69 (absolute 36,200 with polynuclear 97 per cent).

Of the fatal cases none in group one were lost The others may be classified as follows

Case No 37, absolute 33,800, polynuclear 73 per cent, cause ileus; case No 41, absolute 7600, polynuclear 80 per cent, cause embolism, case No 54, absolute 13,733, polynuclear 86 per cent, cause hemorrhage from wound (night of 8th day), case No 71, absolute 13,600, polynuclear 79 per cent, cause pneumonia (post-operative), case No 83, absolute 9600, polynuclear 92 per cent, cause general peritonitis, case No 90, absolute 7600, polynuclear 92 per cent, cause general peritonitis, case No 91, absolute 20,800, polynuclear 90.5 per cent, cause hemorrhage (hæmophilia), case No 92, absolute 23,200, polynuclear 89.5 per cent, cause embolism

Of these cases No 83 and No 90 were extremely serious clinically, and if conclusions may be drawn from this series, and from the work of others, these cases were serious from a hæmatological standpoint Case No 37, both clinically and hæmatologically, should not have been lost, but post-operative ileus developed, and in spite of every effort we were unable to save him Cases Nos 41 and 92 died of embolism (clinically) Case No 71 died of post-operative pneumonia Case No 91 died of hemorrhage, which might have been the result of the necrotic action of the infecting organism upon the walls of the appendicular vein, as the blood could be traced deep in the abdominal cavity near the appendiceal site, and as previously stated, no attempt further than simple drainage had been made in this case

From a hæmatological standpoint, however, the only serious cases should have been No 83 (absolute 9600, with polynuclear 92 per cent) and No 90 (absolute 7600, with polynuclear 92 per cent)

#### CONCLUSIONS

The above figures are interesting for they demonstrate

First, that the absolute count, when taken alone, is of questionable value

Second, that the polynuclear count alone is, in the great majority of instances, a reliable index in diagnosis

Third, that the correlated absolute and polynuclear counts are of greater value than either count taken alone, especially as regards prognosis

A high absolute count with a high polynuclear count means usually good prognosis (*e g*, absolute 35,000, polynuclear 95 per cent) A high absolute count with a moderately low polynuclear (*e g*, absolute 30,000, polynuclear 80 per cent) means usually a very good prognosis A low absolute count with a high polynuclear count (*e g*, absolute 7000, with polynuclear 95 per cent) indicates a grave prognosis (speaking generally)

A low absolute count with a low polynuclear count means (*e g*, absolute 7000 with polynuclear 65 per cent) usually no infection, or

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that the acute condition is due to anatomical or mechanical causes, in other words, that the infection, if one be present, has not stimulated the resisting powers of the body sufficiently to produce a leucocytosis

Fourth, normal or subnormal figures do not necessarily indicate the absence of suppuration, gangrene or their sequels

Fifth, catarrhal cases, fulminating cases, moribund cases and walled off abscesses frequently do not stimulate leucocytosis



# TUMORS OF THE GASSERIAN GANGLION

WITH THE REPORT OF AN OPERATED CASE\*

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TUMORS of the gasserian ganglion have so rarely come to operation that the report of but a single case seems justified together with a review of the literature and the symptomatology. A careful review has brought to light but eight operated cases, Krogus's, Dercum and Keen's, Frazier and Spiller's (2), Giani's, Hofmeister and Meyer's, and Sachs (B) and Berg's, one of Krause's reported by Hartig. Of these Hofmeister's and Sachs's cases alone had relief. The former died nine months later, but had return of symptoms after four months, the latter died two years later of abdominal metastases. Krogus's case died of meningitis. Dercum's had no relief from pain. One of Frazier's cases lived but a few hours, the other for six weeks. Giani's case died of hemorrhage twenty-four hours later. Krause's was not relieved. Aside from a pathological classification of the observed cases, the tumors may be divided into two anatomical groups, those containing nerve elements and therefore either growing from elements in the ganglion or including it in their growth, and those growing from the dura covering the ganglion and compressing the ganglion but not involving it. This fact is most important in explaining the persistent pain that was noted in our case as well as in several of the others operated upon. Diagnostically these two types are not to be differentiated. A much more valuable clinical classification would seem to be a grouping into early and late cases. The case here reported also died of a recurrence, but I feel convinced that if certain diagnostic features of these cases are recognized, these cases may come to operation still earlier and have permanent relief.

In a careful survey of the literature I have found 21 cases that belong to this group. The cases reported by Trénel, Sternberg, French, Soulier, and Klebs are not tumors that arose primarily in the region of the gasserian ganglion, and are omitted. Two cases of Krause's reported by Hartig also do not belong in this group, one was an aneurism of the internal carotid, the other a tumor starting in the posterior fossa. The case of Soderbergh is also a doubtful one.

Of the 21 undoubted cases the early cases are those of Hofmeister,

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\*I am indebted to Dr W W Graves and Dr H. L. Wichmann for following this case with great care after she had left the hospital and procuring an autopsy for me.

Verger and Cardenac, Bezold, Little, Homén, Hansch, Goodhart, Dercum, Keen and Spiller, Dixon, Hagelstam, Krogus, Heslop, Gianì, Marchand, Sachs (B) and Berg The late cases are those of Hellsten, Krepuska, Spiller and Frazier (2 cases), Blessig, and Gunsburg

Of those in which the side of the lesion was mentioned apparently all but Hofmeister's, and Spiller and Frazier's occurred on the left side This fact which seems more than a coincidence suggests that there might be some embryological basis for this, which might throw light on the origin of these tumors, but I have been unable to discover any explanation of this curious fact

In the late cases the involvement of neighboring areas of brain and cranial nerves is so great that it is practically impossible to differentiate the case from one of tumor in the middle fossa arising from the temporal lobe or some structure adjacent to the ganglion Even in this group a study of the onset and sequence of symptoms may show that the process started in the region of the gasserian ganglion The case here reported fits into the group of early cases, and presents what may properly be called the symptom-complex characteristic of this condition

The history of the case is that in December, 1914, the patient began to have pains along the distribution of the ophthalmic division of the left fifth nerve This pain gradually spread and two months later involved all three branches and was continuous At no time was there any cessation of pain Drugs, climatic condition, local applications in no way influenced the pain About this time she complained of double vision on looking to the left Soon after this an impacted molar was removed, but afforded no relief. Some months later her sphenoid and ethmoid sinuses were opened without any improvement in her symptoms The pain continued without any interruption and with great severity

In October, 1915, she came to the Neurological Out-patient Department of Washington University Dispensary Examination showed a well-nourished woman, with intense, constant pain over the entire distribution of her left fifth nerve, paresis of her left sixth nerve, and marked weakness of the motor branch of her left fifth nerve (Fig 1) Study in Dr Schwab's service in the hospital showed no further physical signs The eye grounds were normal, the blood Wassermann was negative The patient was transferred to the surgical side with a diagnosis of tumor of the gasserian ganglion We were unable to add anything to Dr Schwab's study of the case We could find no evidence of increase of intracranial pressure No vomiting or eye ground changes In regard to headache it was difficult to express an opinion, since the pain in the face was so severe Stereoscopic X-ray plates showed no abnormality and none of the signs of intracranial pressure No destruction of bone in the region of the middle fossa could be made out On October 27, 1915, under ether anæsthesia, the approach (Cushing) to the gasserian

ganglion was undertaken. The only difference from the usual procedure was that more bone was removed than usual and the middle meningeal artery was plugged with a wooden peg and cut as it passed through the foramen spinosum. In the region of the ganglion a smooth tumor about the size of a large cherry was exposed, which lay in a cavity in the floor of the skull about 1 cm deep. It had apparently completely replaced the ganglion. The layer of the dural sheath did not have to be opened, as is customary in operating on the ganglion, so that we evidently were dealing with an extradural tumor. At the time of operation, however, this point was not appreciated. It was supposed the tumor had destroyed the outer dural layer. With great care the tumor was dissected free and in this procedure what were taken to be the third and sixth nerves were exposed on the median side of the tumor. The posterior root was evulsed from the pons so that the opening in the dura through which it passes looked perfectly clean. The tumor (Fig 2) was particularly adherent in the region of the ophthalmic branch and in separating this last attachment a very severe hemorrhage occurred. Pressure alone controlled this so that two cigarette drains had to be inserted and the rest of the wound was closed in layers with silk. The patient was transfused with 1000 c c of her husband's blood. She rallied promptly, but when she became conscious was found to have a complete third and sixth nerve paralysis and a complete motor aphasia with very slight weakness of the right hand. The symptoms were attributed to pressure of the drains, so that in forty-eight hours these were removed. No further trouble was encountered and the wound was tightly closed (Fig 3). The motor aphasia began to clear up at once and had completely disappeared on the fourth day after operation. The grip was normal on the second day. By the ninth day there was no trace of the third nerve paralysis and the sixth nerve paralysis improved steadily, so that finally a month after operation there was no longer any double vision. After the removal of the drains a left twelfth nerve paralysis and a herpetic blister on the nasopharyngeal side of the soft palate on the left side was noticed. This twelfth nerve paralysis improved, but at her second admission had not disappeared. The herpetic blister disappeared in two days. Another unusual feature and one difficult to explain was that after the third nerve recovered, the pupil which had been dilated (third nerve paralysis) became contracted. The twelfth nerve paralysis was puzzling. If this was due to the escape of some blood into the posterior fossa, why should only the twelfth nerve on that side have been involved and no other nerve? To clear up this point, Dr. C G Robinson kindly made electrocardiographic studies and pressure tests on the vagi to determine if they were intact. He could find no disturbance. Possibly the tongue paralysis was a central affair. The blister on the pharynx was merely evidence of the total anæsthesia of the fifth nerve, for it supplies that region of the nasopharynx. The anæsthesia fol-

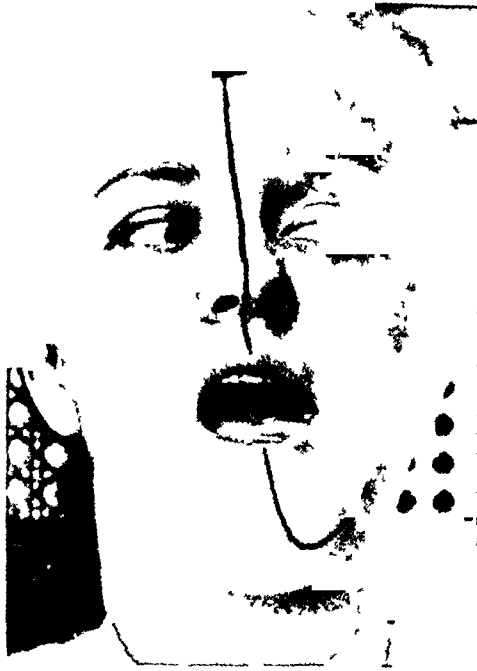


FIG 1 —The mark outlines the area of hypesthesia following operation The deviation of the mouth was present before operation

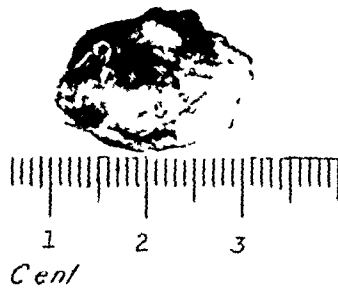


FIG 2 —Tumor removed at first operation



FIG 3 —The operative incision a week after operation

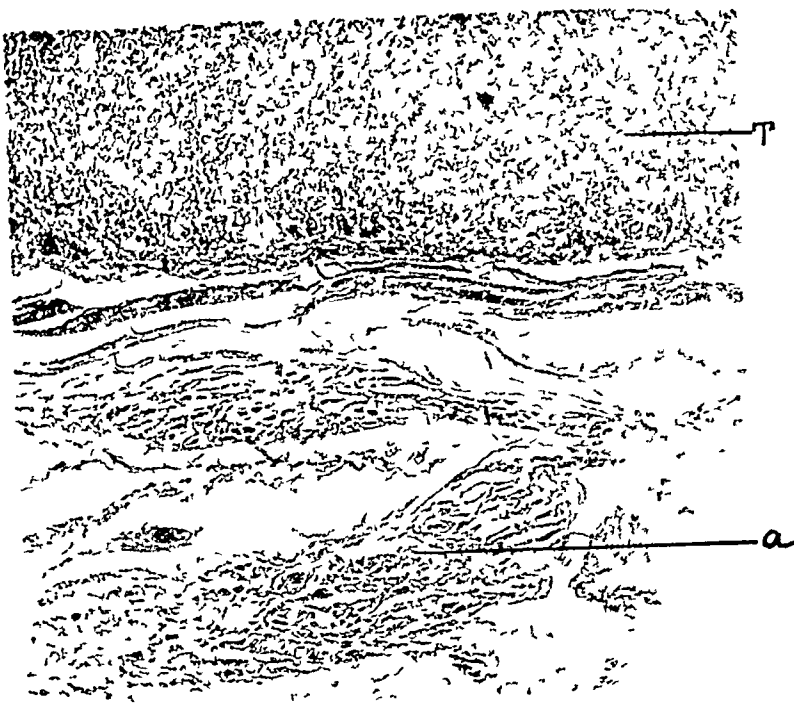


FIG 4 —Section of edge of tumor and flattened gasserian ganglion a ganglion cell, T, tumor



FIG 5 —Low power of tumor showing nest of cells arranged in alveoli a lumen in alveoli, B, area of round cell infiltration with plasma cells

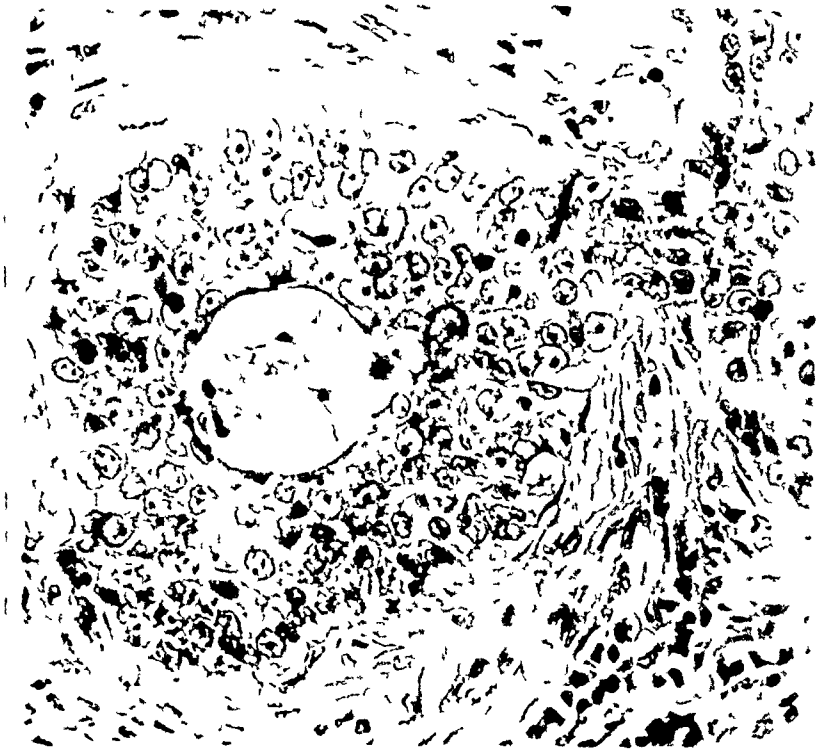


FIG 6 —High power of one lumen shown in Fig 5 The nuclei are packed close together and show several nucleoli

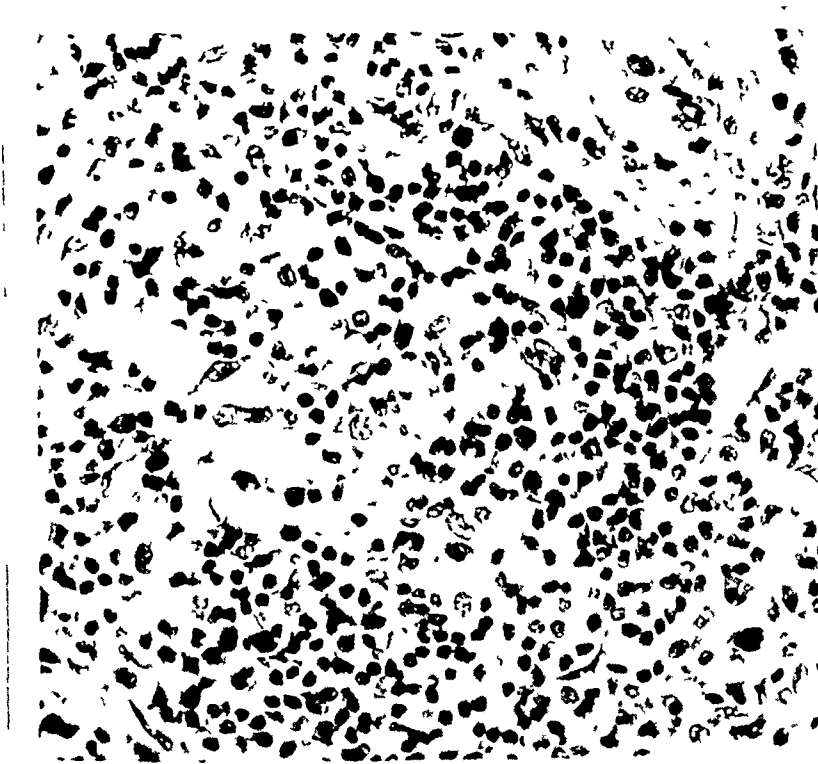


FIG 7 —Area of round-cell infiltration showing plasma cells



FIG 8 —a, area of coagulative necrosis This also shows the tendency to form lumina in the alveoli

lowing the operation was as complete as after the complete evulsion of the sensory root of the gasserian. Serial section of the tumor, however, showed no nerve elements whatever and no structure suggesting the origin of the tumor. The patient was completely relieved of pain and left the hospital about two weeks after her operation.

In about six or seven weeks the patient returned complaining again of severe pains. There still was anæsthesia in the distribution of the fifth nerve, but deep pressure sensation was present. A note in the history at this time read: "There are three possibilities for the recurrence of the pain. First, that the gasserian ganglion being much distorted by the tumor was not seen at the previous operation and a few fibres of the nerve are intact, causing continuance of pain; second, that it is a functional pain from combined causes of operative neurosis and aspirin habit; third, that it is a central pain from organic changes, possible growth of the tumor inwards. It seems wisest to explore in order to be certain that the first and third of these causes are absent."

The subsequent post-mortem examination showed that the gasserian ganglion had been flattened out to mere paper thinness by pressure of the tumor. The opening in the dura through which the posterior root passes from the pons to the ganglion appeared entirely empty, but on careful microscopic section a few flattened nerve fibres were found on the upper inner edge of this aperture (Fig 4, a).

The patient was readmitted on February 10, 1916, and physical examination showed the same condition as at discharge three and one-half months before. The twelfth nerve paralysis was still present. On February 12, through the previous incision, the tumor was again attacked, but was found quite unoperable. A small piece was removed for diagnosis and showed the same histological picture as the original tumor.

The patient left the hospital on February 23, unimproved. She suffered intensely and was kept tolerably comfortable with large doses of morphine. Shortly after the second operation her cervical glands began to enlarge. She became fearfully emaciated. About ten days before her death she lost the sight of her left eye and died on September 15, 1916.

The two conditions which may be mistaken for this condition are tic douloureux and sphenoidal sinus disease. In true tic douloureux, the pain is never persistent or continuous, but it is intermittent in character and comes in spasms. The patient has periods of relief of varying lengths of time. External stimuli may influence the severity of the pain and external applications of heat or some drugs may bring temporary relief.

In true tic douloureux one never sees any cranial nerve palsies.

In sinus disease, the pain may be persistent and of the same character as in ganglion tumor, though never, I think, as severe or excru-



ciating, there may be involvement of the abducens nerve, though this is unlikely, but it is quite impossible ever to have involvement of the motor branch of the fifth nerve since anatomically it is too far from that region

Severe continuous pain in the distribution of the trigeminus with paresis of the motor branch of the fifth nerve justifies at once the diagnosis of tumor of the gasserian ganglion. I do not believe it is necessary to wait, however, until the motor branch of the fifth nerve is involved. As soon as an infected sinus has been excluded the persistent pain as distinguished from the intermittent spasmodic pain of tic douloureux justifies an operation on the ganglion on the suspicion that a tumor is present.

A considerable number of these tumors have been studied pathologically. In the last fifty-two years the literature contains 37 cases. These have been reviewed with particular care as to their pathology by Marchand and Gianì. Though various diagnoses have been made in these cases, varying from carcinoma to sarcoma and endothelioma, the consensus of opinion has been to call them endothelioma. It seems probable that at least some of the cases called carcinoma belonged to the endotheliomata.

The salient features that Marchand emphasized are a reticulum of connective-tissue fibrils which seem to be part of the dural covering of the ganglion. Scattered through this are round or polygonal epithelial-like cells with clear homogeneous transparent cytoplasm. In places the growth looks like a large round cell sarcoma but in many places like a malignant epithelial tumor. At times there is acinar formation. These facts, together with the peculiar relation to the ganglion cells, led Marchand to think that these cells might be identical with those lining the capsule of the ganglion cells and also the cells of the sheath of Schwann. If this is correct, the tumor would be an endothelioma. Further study raised the question in Marchand's mind whether the tumor had not originated in the undifferentiated stage of the ganglion anlage, and if that were so the tumor should be called a "Neurozytoma." Gianì's description adds nothing new. His case was complicated by tuberculous lesions in the tumor.

Our tumor on inspection appears well encapsulated, but on section there is one portion where the growth evidently was not completely removed. The first impression on looking at the section is that we are dealing with a carcinoma (Fig 5). The sections of the tumor removed at operation and at the subsequent autopsy show the identical processes, but, as will appear later, ganglion cells were only found in the autopsy specimen.

The tumor removed at operation was cut in serial sections and stained with hæmatoxylin and eosin, van Gieson, Pal Weigert and polychrome methylene-blue. The serial sections of the tumor showed nowhere any ganglion cells. The tumor is composed of a loose reticu-

## TUMORS OF THE GASSERIAN GANGLION

lum of connective tissue interspersed with many lymphatic channels and a moderate number of capillaries. Scattered throughout this mass are nests and strands of cells which are arranged in alveoli. These alveoli form anastomosing columns of great complexity. They are composed of cells whose outlines are determined with much difficulty. At times they resemble a mass of syncytium, but in other places the cell outlines are quite well defined. The cytoplasm is finely granular and vacuolated. Although most of the alveoli are packed solidly with cells there are a few in which there are rounded spaces and sometimes a definite round lumen in which there lies some granular material. There are numerous nuclei closely packed together which are round or oval and vesicular and contain one or two darkly staining nucleoli. The cells have not the sharply defined outline and regular rounded nuclei of epithelial cells. There are no intracellular bridges.

Scattered through the connective-tissue stroma are areas of round-cell infiltration with numerous plasma cells. These are grouped around blood-vessels.

There are areas in the specimen of rather homogeneous masses which take the eosin stain diffusely and evidently are coagulative necrosis (Fig 8). What the significance of these areas is or what their relation to the tumor proper, it is not possible to decide.

The sections of the tumor taken at autopsy show the same characteristics, but the cells vary more in size and show more evidence of mitosis. These sections show at their margins the frayed-out remnant of the gasserian ganglion (Fig 4). It is remarkably compressed, at its broadest diameter it measures but 35 millimetre. This marked thinning explains why its root was not seen at operation. The nerve cells without exception show degenerative changes, many of them have no nuclei and the Nissl bodies either do not stain at all or are very abnormal. In some cases the Nissl bodies are gathered in a small mass about the nucleus. These cells are atypical in form and are flattened, showing the effect of prolonged compression. There is evidently also a very marked diminution in the number of these cells. There are some empty spaces in which ganglion cells had been lying but no trace of the cell remains.

In deciding on the nature of this tumor several points have to be considered. In the first place, this tumor arose in a region where there is no epithelial tissue, and from the intimate attachment of the tumor to the dura in the region of the cavernous sinus as found at operation it is fair to assume that this is the origin of the tumor. A comparison of this tumor with those published by Marchand, and Gianì and Spiller<sup>1</sup> shows a striking resemblance. We feel justified therefore in calling it an endothelioma.

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<sup>1</sup>Through the kindness of Dr W G Spiller, I have had an opportunity of studying the section of one of his cases which is identical with mine. I have also examined sections of Dr B Sachs's case (removed by Berg) and this seems to be a sarcoma.

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## BONE TRANSPLANTATION FROM SCAPULA FOR DEFECT IN SKULL

BY BERT LOGAN JONES, M D , C M  
OF WALLA WALLA, WASHINGTON

PATIENT "H," aged twenty-six For the past four years had suffered from attacks of confusion, occurring about once a month, due presumably to a defect in his skull, due to traumatism at the age of four years Examination shows absence of bone protection over an area of approximately 3 cm by 5 cm in the left frontal region (Fig 1)

Inspection showed marked pulsation During attacks of confusion there would be marked bulging over the area Patient was rational but lacked energy to carry out any line of work

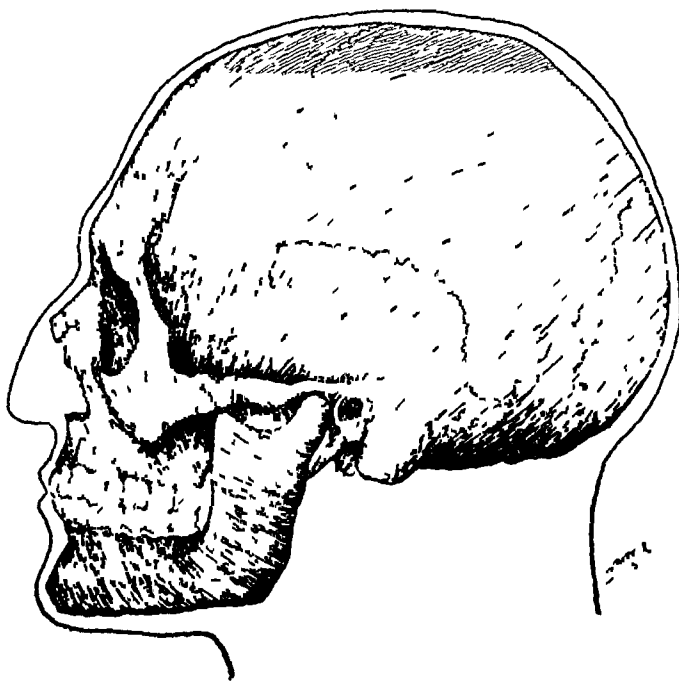


FIG 1 —Showing defect in skull to be filled by transplant from the scapula

May 25, 1916, a piece of the left scapula was first removed (Fig 2) and placed in a saline solution The piece was slightly larger than the opening of the defect in the skull The incision was closed

A flap was then turned down and dissected from its adhesions to the dura mater, exposing the skull defect The piece of scapula was then placed in the opening of the defect, and its periosteum and the periosteum of the skull sutured The flap was replaced without drainage

## BONE TRANSPLANTATION FROM SCAPULA

*Post-operative Course* —There was one marked convulsion on the morning following the operation. Aside from four slight attacks at lengthening intervals, the recovery was uneventful. Patient left hospital October 9, 1916.

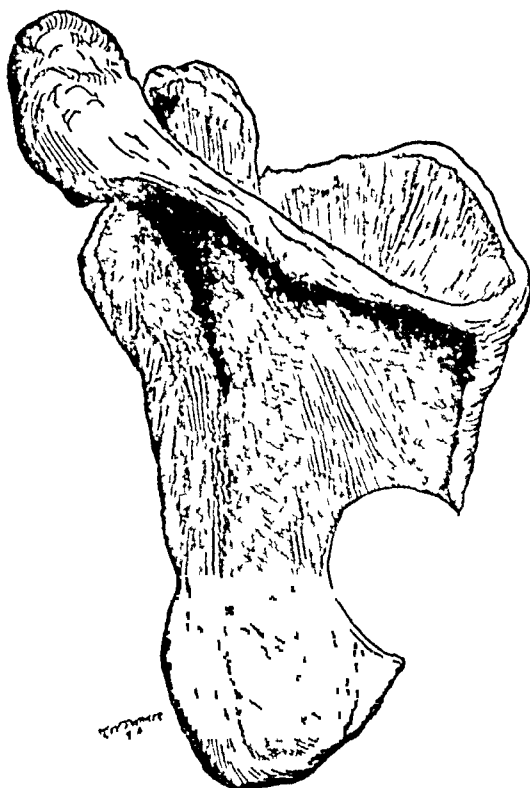


FIG 2 —Showing portion of scapula removed for transplantation

Part being firm, bone-reunion apparently has taken place. The patient's mental and physical condition was markedly improved.

The scapula was used for the reason that it was a flat bone and was covered with a periosteum.

The accompanying drawings show the location of the defect and the region of the scapula from which the piece of bone was taken.

# THE VALUE OF BONE AND CARTILAGE TRANSPLANTS IN RHINOLOGICAL SURGERY †

BY WILLIAM WESLEY CARTER, M.D.  
OF NEW YORK CITY

IN bringing this subject before you my chief object is to show, by the radiographic history of certain cases that I have operated, the true value and permanent qualities of bone and cartilage as a transplant in the correction of nasal deformities and defects due to the destruction by disease and traumatism of the bony and cartilaginous framework of the organ. My observations are drawn from a close clinical and X-ray study of some of my oldest cases.

I began this work over eight years ago, and having transplanted bone both with and without periosteum, with and without contact with the living skeletal bones, I feel that a sufficient time has elapsed to enable me to say that these cases show accurately the history of autogenous bone and cartilage transplants in the human body. I may state further that this procedure, having been subjected to the crucial and ultimate test of application to a number of human subjects, and the results having proved satisfactory, I feel that I may confidently advocate its use both from a scientific and practical point of view.

Animal experimentation is of great assistance in the development of ideas, and it enables one to reach conclusions approximately correct as to the value of surgical procedures when practised upon the human subject. The results obtained by the vivisectionist, however, must be verified by the supreme test of application to the human body. In the case of bone transplantation no statistics as to the value of the periosteum, the vitality of the transplant, its absorption or non-absorption, etc., obtained by animal experimentation, could be applied to this operation on the human subject for the reason that in the case of lower animals it is practically impossible to secure and maintain asepsis or to keep them quiet until the healing process is complete. Infection, even if it does not cause the transplant to slough out, exerts a marked influence on the vitality of the graft. A certain amount of motion increases osteogenesis in the live, skeletal attached bones after injury, but upon the transplant itself it has the opposite effect, since it has been suddenly cut off from its normal blood supply. It must be remembered that the primary newly-developed capillaries which supply the transplant with blood in its new position are extremely delicate (their walls consisting of only one layer of cells) and that they may be destroyed by the most trivial traumatism. This would

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\* Read before Bellevue Hospital Alumni Society, New York City, and American Academy of Ophthalmology and Oto-Laryngology, December 12, 1916, Memphis, Tenn.

at least cause a delay in the healing in of the transplant, if not its death and subsequent expulsion. It will be seen, therefore, that while conclusions may be drawn which apply to the animal itself under the conditions which animal experimentation must be done, these results can scarcely be considered as furnishing more than presumptive evidence as to what will happen when bone is transplanted in man, or at least statistics as to the fate of the transplant, the value of the periosteum, etc., in animals would be inaccurate when applied to man, where conditions are different and where rest and asepsis can be easily obtained. Another element of greatest importance is time. Bone is a tissue comparatively slow in its metabolic processes, therefore a considerable space of time should elapse before we can estimate with any degree of accuracy the final results and the ultimate disposition of the transplant in the tissues. Where the animal is killed a few days after the operation, no reliable data can be obtained and statistics based upon such experience throw no light upon the science of bone transplantation. Almost any foreign body introduced into the body under aseptic conditions can be made to heal in, and it may remain for a long time, but sooner or later it will be expelled, especially if it has resistance to overcome. For this reason no foreign substance can be used successfully to elevate a sunken nasal bridge, for here it is subjected to constant pressure due to the elasticity of the skin. In freshly removed bone and cartilage, on the other hand, we have a live connective tissue capable of being transplanted into another part of the body without losing its vitality, and where it may be used to replace bone and cartilage that has been destroyed by accident or disease.

The interesting question arises as to what part the transplant plays in the process of repair, and what may be the influence of the periosteum, and what are the relations between the transplant and the surrounding tissues. To determine this a considerable time must elapse after the operation. The cases of my series which I have carefully studied with a view to determining these matters are of long standing and show in the serial radiographs very clearly what has taken place. It is my belief that the contradictory conclusions reached by different writers upon this subject are due to differences in the methods of operating, in the anatomy of the parts operated upon, in the site of the operation (allowing for mobility or fixation during healing), in the presence or absence of infection, and in the time that has elapsed since the operation. Reliable data can be obtained only by studying the progress of a number of cases after the ideal operation. By ideal operation, I mean *where an autogenous transplant has been introduced aseptically in a position in the human body where perfect immobility can be secured*. No part of the body is better adapted for securing these conditions than the nose. In addition, the abundant



blood supply to the organ insures to the transplant a maximum of nutrition and resistance to infection

My work in this field has been confined to transplantations into the nose, with the exception of one case, in which the bone was first transplanted into the arm and then the flap containing the bone was later transferred to the face. This was in a case where the patient had no nose.

Sixty-one cases are included in my series. A number of these have been kept under close observation and have from time to time been X-rayed and at intervals they have been brought before the Laryngological Section of the New York Academy of Medicine for observation and comment. I do not consider a case of less than a year's standing old enough to furnish data of any value in determining final results.

It is not my purpose on this occasion to dwell upon the cosmetic results secured in my work. I will say, however, that no case has been rejected on account of its severity and that some of my cases have been most difficult. In degree of deformity they have ranged from slight depressions, easily corrected by the transplantation of a spur or portion of a deflected septum removed at the time of the operation, to absence of the entire nose. In many of my cases where the deformity was very great and there was no bony framework left in the nose, my only expectation at the first operation was to raise the bridge of the nose to a moderate degree, my chief object being to establish a bony foundation securely anchored to the frontal bone upon which to build up a nose by the transplantation of more bone and cartilage at some later date. In one severe case I constructed a V-shaped pier from two strips of bone and upon this was placed the long dorsal strip, the result in this case was very satisfactory. In others several strips of bone were superimposed. In these cases only the outer strip was periosteum-covered. These cases show distinctly the influence of the periosteum on the growth of the transplant.

In estimating the value of my methods from a cosmetic point of view, therefore, one must take into consideration the fact that a majority of my cases were extreme deformities. I will say that the results have been excellent in many of these, and in others the improvement is marked. In none has the deformity been increased. I can state positively that I know of no other method for the correction of this class of deformities so efficient as that of bone and cartilage transplantation.

The following were etiological factors in my series of cases: Congenital defects and malformations, traumatism, syphilis, tuberculosis, atrophic rhinitis, the submucous operation and abscess of the septum.

Logically and practically the use of the patient's own tissue for transplantation, the autoplasmic operation, is the best method. Here, as I stated in my first communication on this subject, there is no incompatibility between the elements of the transplant and those of the

receiving tissues; for the arrangement of the atoms in the molecule of the two is the same. We have therefore in the wound serological conditions most favorable to immediate healing, which is especially desirable in the transplantation of bone.

I have used bone from another patient on only two occasions, and both times the transplant had to be removed, in one seven days, and in the other ten days, after the operation. I will say, however, that in both instances the wound was infected, so that the failure of the graft to take could scarcely be attributed to serological differences between the transplant and the receiving tissues.

The use of tissue from an animal of a different species, the heteroplastic operation, I have never tried, as I believe that only the best known methods should be applied to the human subject. Many such operations have been reported, but the success of these does not compare with that of autoplasmic transplants. Heteroplastic transplants are always absorbed.

I will admit that my early work in this field was largely experimental, but the cases selected were so badly deformed that I knew no injury would be done even if the transplant had to be removed. The hypothesis upon which I began this work was, that bone is a form of living connective tissue, and that a fragment removed from one part of the body and transplanted aseptically into another part of the same body would retain its vitality, being first nourished by the serous pabulum which surrounds it, and later by a network of new capillaries developed from the surrounding tissues. This view was contrary to the belief held at that time by histologists, anatomists and pathologists who believed that a bone transplant was dead tissue, and that it was always absorbed and that new bone was deposited in its stead. My series of carefully observed cases, some of several years' standing, shows that the original transplant is not only not absorbed, but that it lives, takes part in the local processes of repair and grows, its growth being subject to the law of functional adaptation. It proves, contrary to the belief of some pathologists, that mature bone is not a dead tissue, but like other tissues undergoes metabolism throughout the life of the individual.

Murphy's view that transplanted bone is merely osteoconductive is altogether at variance with the results shown in these cases.

Nasal deformities naturally fall into two groups. (1) Those cases in which the deformity is due to a dislocation of the anatomical structures of the nose. These may be corrected by the local transposition of tissue, by the use of the bridge-splint and by various mechanical devices. (2) Those cases in which either from accident or disease there has been an actual destruction of the bony and cartilaginous framework of the nose. These cases may be further complicated by more or less mutilation or destruction of the soft parts and by cicatricial contraction.

Cases belonging to this second group come under our present consideration and may be corrected by the transplantation of bone and cartilage

I have found the rib well adapted for this purpose. It is well supplied with nutrient foramina, it is properly shaped, it is easily accessible and the removal of a section causes the patient little or no inconvenience. The defect is quickly filled in by bone developed from the stumps of the rib. The end of the rib with a portion of its costal cartilage is the part used. This enables me to repair the bony portion of the bridge with bone and the cartilaginous with cartilage. Thus establishing normal conditions as nearly as possible and preserving the flexibility of the nasal tip.

*The operation by the external route* is briefly as follows. The nasal cavities are cleansed with Dobell's solution. The eyebrows are covered with flexible collodion, after thoroughly scrubbing the entire face with green soap and water, followed by alcohol. The nose and adjacent portions of the face are then painted with tincture of iodine. The right side of the chest is prepared in the same manner. No antiseptic is used after the first incision. I use only freshly sterilized physiological salt solution.

A curvilinear incision, convexity downward, is made between the inner extremities of the eyebrows. This incision extends down to the periosteum. With a spatula-shaped knife, slightly curved, and having three cutting edges, I then elevate the tissues over the dorsum of the nose down to the tip, and if the deformity is very great over the sides as well. If the nasal bones are present, I keep as close to them as possible, endeavoring to strip up the periosteum. After elevating the tissues over the nose, I lift up the semilunar flap made by the first incision and make a horizontal incision through the periosteum into the frontal bone. Care is taken to cut deeply into this bone in order to excite osteogenesis necessary to bind the end of the transplant to this bone. The so-called periosteum over the frontal bone is not an osteogenetic membrane and it serves our purpose in this instance merely to hold the end of the transplant in position.

I next proceed to resect about two inches of the ninth rib. This segment is taken from the end of the rib, and consists of two-thirds ribs and one-third costal cartilage. The periosteum on the anterior surface of the transplant is preserved. The segment removed is split and the outer half which is covered by periosteum is shaped to suit the deformity. It is then placed in the bed prepared for it in the nose, the cartilaginous end reaching nearly to the tip and the upper end being securely tucked under the periosteum in close contact with the frontal bone. The semilunar flap is then brought down into position and the wound closed with horse-hair sutures.

This external operation is probably better suited to the very severe cases, especially where there is much scar-tissue, than the intranasal method which I shall presently describe.

No effort is made to expel the blood-clot which fills the wound made in elevating the tissues over the nose, for this temporarily nourishes the transplant and later favors osteogenesis.

No manipulation of the part should be permitted, and the case should not be exposed to the X-rays until the transplant has become fixed in its new position and we are quite sure that its vascular connections have been established. On three occasions an early X-ray exposure (the ninth or tenth day

FIG 1



FIG 2



FIG 3



FIG 4



FIGS 1-4 —Traumatic deformity corrected by intranasal transplantation of conjoined bone and cartilage

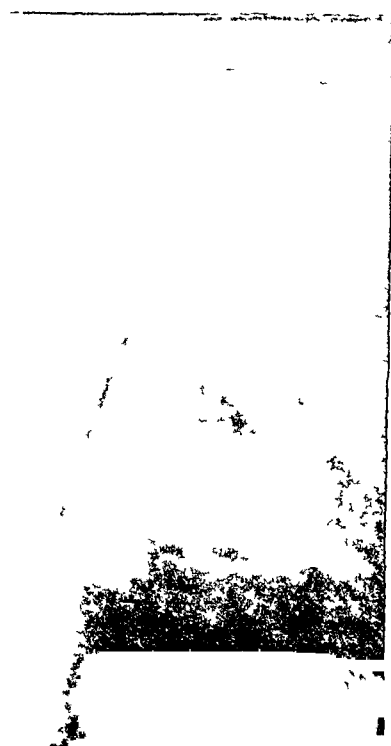


FIG 5 —Congenital deformity corrected by superimposing three fragments of bone Intranasal method

FIG 6 —Pier operation for congenital deformity



FIGS 7 and 8—Traumatic deformity corrected by intranasal transplantation of conjoined bone and cartilage

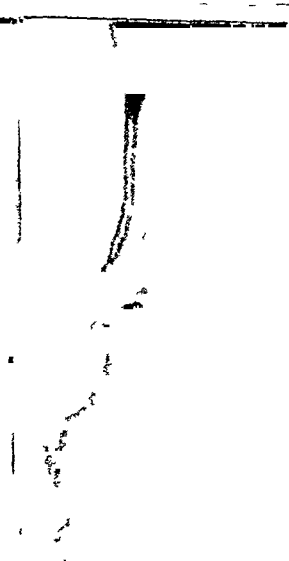
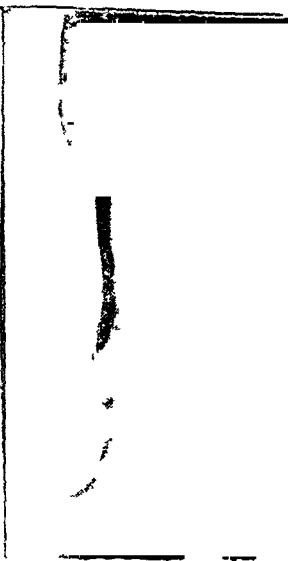


FIG 9—Congenital deformity. Periosteum covered transplant seven months after operation

FIG 10—Same case as Fig 9 twenty months after operation

FIG 11—Same case as Fig 9 two years and four months after operation. Note thin line of absorption in centre of transplant

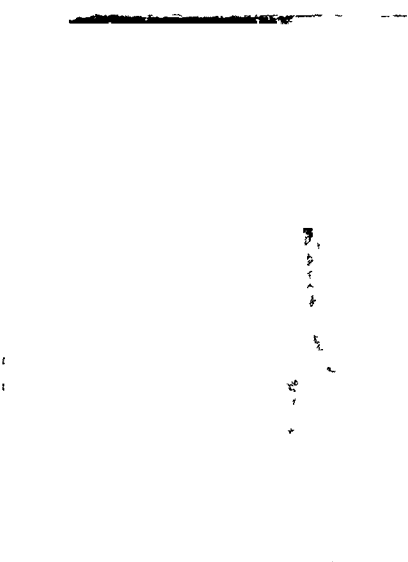


FIG 12—Same case as Fig 9 three years after operation

FIG 13—Same case as Fig 9, four years after operation

## TRANSPLANTS IN RHINOLOGICAL SURGERY

after the operation) seemed to interfere with the healing process within forty-eight hours after the exposure to the ray there was a slight non-inflammatory bulging at the site of the incision. An opening was made and there was a slight discharge of serum, there was no pus formation and the cases progressed satisfactorily afterwards. I may have been mistaken in attributing the disturbance to the X-ray, but the clinical connection seemed to be so evident that I have been careful since this time not to expose the patient to the rays too soon after the operation.

Recently I have ceased to use the external route for the introduction of the transplant save in the very marked and difficult cases.

*Operation by the Internal Route*—In this operation the transplant is prepared as I have just described. The left nasal cavity is sterilized and the tip of the nose is raised with the left thumb. The spatula-shaped knife is introduced through the roof of the nasal cavity at a point corresponding to the interval between the upper and lower lateral cartilages. Through this opening the tissues over the dorsum of the nose are elevated and a pocket is made towards the tip. The transplant is introduced, then by pulling on the tip of the nose the lower end is slipped into its pocket near the tip. No suture is used to close the wound as the edges naturally fall together. The nostril is packed with vaseline gauze for twenty-four hours.

This method in suitable cases is far preferable to the external route, as the wound is at the lowest point of the submucous sac and thus drainage is facilitated. There is no external scar, and in my opinion there is less danger of infection, for it must be remembered that the normal nasal secretions inhibit if they do not actually destroy bacterial growths.

In the cases I have done by the intranasal route the results have been excellent, the swelling has been less than by the external method and there have been no cases of infection.

If the deformity is marked, several fragments of bone may be superimposed. This is preferable to using one large fragment, as small transplants possess relatively greater osteogenetic power than large ones.

In cases of moderate deformity, where there is a septal spur or deflection, this may be removed by the submucous operation and transplanted into the bridge of the nose by the intranasal route. I have on several occasions used septal cartilage removed from another patient, in closing a perforation of the septum. In these cases the cartilage seems to serve as a bridge for the mucous membrane.

*Operation for collapsed alæ due to loss of muscular tone*—The following procedure which I have used only once proved so efficient in relieving a patient of this very annoying condition, I feel that I am justified in describing it. With a very sharp scalpel both alæ were split their entire length to the depth of about three-eighths of an inch. Two thin curved strips of cartilage were then introduced and the wound closed with horse-hair sutures. The nostrils were kept distended with vaseline gauze for several days. When healing was complete the openings were considerably larger and the patient was entirely relieved.

Time will not permit me to describe the interesting cases that have come under my observation, and the cosmetic results secured by the transplantation of bone and cartilage. The chief object of this presentation is to call your attention to the value of bone and cartilage as a constructive material, and to demonstrate by serial X-ray plates that the vitality of this tissue, when properly transplanted, is not im-

paired but that in its new position it lives and grows, its growth being limited by the functional demands of the part

The following conclusions are based upon my interpretation of the clinical and X-ray evidence presented by the cases that were operated upon from three to five years ago. Bone and cartilage present about the same vitality and resistance to infection.

Infection occurring in the wound does not necessarily mean the destruction of the entire transplant, if the infection is quickly controlled. But a part at least of the transplant will be absorbed.

A transplant stripped of its periosteum, and placed in the soft tissues of the nose, remains alive and is not absorbed, but it does not exhibit the vigorous growth noted in the periosteum-covered transplants.

Bare bone contacted with live, periosteum-covered bone is osteoconductive and osteogenetic and is not absorbed. Periosteum-covered transplants contacted with live periosteum-covered bone continue to live and perform their function uninfluenced by their change of position in the body. This is the ideal transplant for use in all the departments of surgery.

The periosteum, *per se*, does not reproduce bone.

I must conclude, therefore, that while the periosteum is necessary to the vigorous growth of bone, the bare compact bone takes an active part in the production of bone.

In closing I may add that in bone and cartilage transplantation I believe that we have an aid which will prove of great value in solving some of the difficult problems which confront us in rhinological surgery.

# FACTORS BEARING ON THE MORTALITY IN OPERATIONS FOR BILIARY OBSTRUCTION BY CALCULUS<sup>1</sup>

BY FREDERICK T. VAN BEUREN, JR., M D  
OF NEW YORK

It is easy, of course, to understand why operations for common duct obstructions show a higher death-rate than those for stone in the gall-bladder. In the former case we have to do with a condition that is almost certainly of long standing, a disease whose product has deprived the organism, for its useful purposes, of the proper secretion of its largest, and, in some cases, of its two largest glands, and has forced them, commonly speaking, to stew in their own juice. Add to this the possible distant effects, on the tissues, of resorbing these secretions, keep in mind the fact that certain chemical combinations which may be poured harmlessly through the alimentary tract, are decidedly poisonous on direct introduction into the blood stream, and one cannot but agree that, contrasted with a stone blocking the common duct (especially at its duodenal terminus), a gall-bladder full of nicely polished calculi is more or less comparable to a pocket full of cherries. Barring infection and impaction it is apparently no less comfortable and only potentially more dangerous to the owner.

In this analysis, however, we are concerned not with the relative danger between operations upon the gall-bladder and operations upon the common duct, in general, but rather with the relative danger between our operations and those of others upon cases supposedly similar. And any attempt to determine this relation must take under consideration those special factors which others have said to be, or which we ourselves have come to look upon as, probable determinants of a fatal issue. Among these are (1) the age, (2) the general condition of the patient, (3) the duration and severity of the symptoms for relief of which he was operated, and (4) the question whether the operation was done during one of the attacks or in the interval between, (5) the difficulty and the consequent length of the operation and the traumatization of the tissues must also be considered, (6) drainage of the bile passages must be noted, and (7) complications must be carefully scrutinized to determine whether they were avoidable or not. And when we have done all this we shall be in a position to make at least a fair guess why the patient died.

In examining the records of the following cases I must explain that I did not see these operations and that criticisms which I have appended in three instances may not be justified.

The records are those of nine cases that died after operation for

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<sup>1</sup>Read before the New York Surgical Society, February 28, 1917



- calculous obstruction of the common bile-duct at the Roosevelt Hospital during the years 1910-1914, inclusive

In this same period there we had a total of thirty-four such operations, so that our mortality seems extraordinarily high when compared with the Mayo Clinic, 8 per cent (Collected Papers by the Staff of St Mary's Hospital, Mayo Clinic, 1911), and Erdmann's, 8 per cent ("Biliary Surgery," John F Erdmann, ANNALS OF SURGERY, December, 1914), mortality in common duct operations

CASE I —The first of these nine cases (A268) was a feeble old man of seventy-two years, in poor general condition. He had had his first similar attack twenty years previously, and had been free for eighteen years. The present attack had begun recently and was progressing with acute pain, chills and fever, increasing jaundice, temperature 102° F, pulse 90, respirations 24, white blood count 35,000 (polymorphonuclears 84 per cent). In his case operation was delayed thirteen days in the hope of improving his condition, but acute symptoms were still present at this time and the operation was extremely difficult. The common duct was found packed full of stones and a putty-like mass and the obstruction was complicated by cholangitis, chronic pancreatitis and a spontaneously-formed fistula between gall-bladder and duodenum. The duodenum had to be opened and sutured, cholecystectomy was performed and drainage secured into the upper part of the common duct. He developed signs of pneumonia on the second day after operation and died on the sixth, apparently of pneumonia. If the cholecystoduodenal fistula could have been left undisturbed the operation would have been shortened and some trauma avoided.

CASE II —An elderly man (A1431) over fifty (exact age unknown), in fair general condition. His first similar attack of pain had occurred twelve years before admission and, following several similar attacks three years later, he had discovered gall-stones in his stool. A long free interval had intervened, but he had had renewed attacks in the three years previous to admission, the last, with chills and fever, five days before. He still had some tenderness and rigidity and a white blood count of 23,000 (86 per cent polymorphonuclears), although his temperature was only 99.6° F, his pulse 76 and his respirations 20. The operation included cholecystectomy of a large gall-bladder containing *Bacillus coli* and many stones, and drainage of the common duct by tube, through the cystic junction, after removing two calculi. His temperature had reached normal on the eighth day, and his convalescence seemed well established, but a hernia was noted (in the scar) which necessitated operative interference on the eleventh day after his choledochotomy, the sutures in the rectus sheath having suddenly given way. His temperature reached normal on the third day after his second operation and remained so till the

sixth day, when he had a sudden rise to  $105^{\circ}$  F and died the next day with a temperature of  $107^{\circ}$  F, without signs of pneumonia or peritonitis. It may of course have been the overwhelming toxæmia of a pneumonia that allowed no time for signs to develop.

CASE III—A woman (A1983) forty-seven years old, very acutely ill, whose general condition was unfavorable, due to marked adiposity and a distinct chronic nephritis. Her trouble had begun eight years before with pain and jaundice and had been more or less continuous. The attack which brought her in to us had begun only a day or two previously and she had been jaundiced for twenty-four hours, was suffering severe, constant pain, had temperature of  $106.8^{\circ}$  F, pulse 124 and respirations 44. Her white blood count was only 7000 (89 per cent polymorphonuclears). Immediate operation was undertaken and proved long and difficult (1 hour 45 minutes), for her gall-bladder, which was small and indurated, was closely adherent to the duodenum and had ulcerated partly through its wall, while the hepatic and common ducts were enormously dilated and packed with forty stones of  $\frac{1}{8}$  to  $\frac{3}{4}$  inch in diameter. Operation failed to relieve this woman and she died on the second day after operation, with high temperature ( $106.4^{\circ}$  F) and rapid respirations (48 per minute) but without frank signs of pneumonia. Considering her high temperature and rapid respiratory rate on admission we might (except for the low white blood count) believe that she had pneumonia before her operation, but, without other clinical signs, it is not possible to say whether the toxæmia that overwhelmed her had its origin above or below the diaphragm.

CASE IV—A man (A2120) fifty-nine years old, who had formerly been a very heavy drinker and whose liver was tremendously enlarged, with its free border four inches below the costal margin. His general condition was further reduced by a well-marked chronic nephritis. Attacks of pain similar to the present had begun two years before and the present attack had started about three weeks prior to admission, with sharp pain for twenty-four hours, followed by dull aching, and jaundice appearing thirty-six hours after the onset of pain. This was his initial attack of jaundice and was still present, though not increasing, at the time of operation. His temperature ran from  $100^{\circ}$  to  $103^{\circ}$  F, his pulse about 80 and respirations 20. His white blood count was 12,000 (87 per cent polymorphonuclears). By a transduodenal choledochotomy a large calculus impacted in the papilla of Vater was removed together with multitudinous small calculi that lay above it in the duct. The duodenal wound was sutured and the abdominal wound closed around a cigarette drain. The operation took only forty-five minutes and presented no special difficulties and is the only one of this group that did not provide for external drainage of the common duct. His obstruction was relieved and his wound healing progressed satisfactorily, but, on the third day after operation, his temperature rose again, signs

of consolidation appeared over the left lower lobe and spread progressively until his death (with pulmonary cedema) on the eleventh day after operation, apparently, of pneumonia

CASE V—An elderly woman (A2802) over fifty years (exact age unknown), in poor general condition from a chronic cardionephritis with a blood-pressure of 170-210. She had symptoms of gall-stone trouble for many years, but this operation may fairly be called an "interval" one. A shrunken gall-bladder with minute calculi was removed and several soft calculi were extracted from the hepatic and common ducts through an incision in the dilated common duct, which was drained as usual. After operation, persistent vomiting with suppression of urine and signs of cardiac dilatation appeared and she died on the second day after operation, apparently of cardiac failure.

CASE VI—An emaciated young man (B922) of twenty-six years, in bad general condition, convalescing from an operation for opening an abscess in the gall-bladder region one month before. He had lost thirty pounds in the preceding six months, had been jaundiced for five months, and had had his gall-bladder drained two months before his admission. At the time of his admission he was still jaundiced and was having diarrhoeal, clay-colored stools containing free fat. His temperature ranged between 99° and 104° F, his pulse from 92 upward and respirations 24. His white blood count was 21,000 (82 per cent polymorphonuclears). His operation was exceedingly difficult, lasting one hour and twenty minutes, removed fifteen calculi from the junction of the hepatic ducts and discovered an inflammatory mass with small abscesses in the liver, pus in the bile, a hard mass in the head of the pancreas and a stricture of the common duct about 2 cm above its duodenal terminus. It is not stated that operation relieved this stricture, but the common duct was drained by the usual rubber tube. The bile contained *Staphylococcus pyogenes aureus*. This poor fellow hung on to life for three weeks, in spite of persistent diarrhoea and increasing weakness. His jaundice had almost completely disappeared and bile had appeared in the stool on the seventh day after operation, but his temperature continued high and he died, apparently of asthenia, on the twenty-second day after operation. Autopsy revealed that he had tuberculosis of the peritoneum as well as his other lesions. The masses in his liver and pancreas were chronic inflammatory tissue.

CASE VII—An emaciated male (B1293) of forty-five years. He had the look of chronic illness and a definite tuberculous lesion was evident at his right apex. He had had recurrent attacks of pain and jaundice for three years, chills and fever and an enlarged spleen. His symptoms were not acute at the time of the operation, which removed one large calculus from just above the pancreatic portion of the common duct together with many small ones from the gall-bladder and drained both with rubber tubing. His post-operative course was stormy, with distention

and vomiting. Signs of pneumonia developed, his white blood count rose steadily, his temperature remained up, and, in three weeks after operation, the patient vomited bloody fluid and had a bloody discharge from the wound which had not closed. On the twenty-ninth day, an exploring needle, in the eighth costal interspace, revealed pus. A subphrenic abscess containing Gram-negative bacilli was immediately drained, but the patient failed to rally and died on the thirty-first day after operation, apparently of weakness due to sepsis and pneumonia.

CASE VIII—A woman (B1873) of forty years who looked very acutely ill, with rapid, shallow respirations. She had suffered from "indigestion" for four or five years, but had never had an attack like the present and had never been jaundiced. The present attack had begun several days before admission with vomiting and severe colicky pain, which had become slight during the last eighteen hours. She had a tender mass in the right upper quadrant of the abdomen with well-marked muscular spasm. Temperature 104° F, pulse 120, respirations 28 and white blood count 10,000 (72 polymorphonuclears). She was the only case of the series without jaundice and her obstruction was evidently of very recent origin. Immediate operation disclosed an abscess containing five ounces of pus lying to the inner side of a small, thickened gall-bladder surrounded by dense adhesions. Two large stones (which lay below the cystic and one and one-half inches apart) were removed from the common duct together with much fine gravel and thickened bile from the hepatic and cystic ducts. Typhoid bacilli were cultured from the pus around the gall-bladder. After operation her urine was free from bile on the second day, but signs of beginning consolidation in the lower lobe of the right lung appeared, her temperature rose gradually to 106.8° F, and she died on the fourth day, apparently of pneumonia and sepsis. This woman might have had a better chance if her abscess had been drained and the duct operation delayed to give her a chance to get up resistance (as in Case B1393—a nephritic in poor condition, who had her gall-bladder drained and recovered so well as to undergo two successful choledochotomies within six months afterward).

CASE IX—A woman (B4449) of sixty-eight years, in bad general condition. She had had similar attacks four years before, relieved by cholecystostomy, and a free interval till ten months previous to admission. Since that time attacks had been frequent, she had been continuously jaundiced and had lost thirty-one pounds. At the time of her operation she still had pain and jaundice and a tender mass in the gall-bladder region, but her temperature and white blood count were within normal limits. The operation was long and difficult on account of mass adhesions, including the removal of a distended gall-bladder infected with *Bacillus coli* and *Bacillus typhosus* and the removal of a calculus from the common duct and drainage of the latter

The patient left the operating table in poor condition and died six hours later, apparently of operative shock. It is just possible that this woman, also, might have done better with a preliminary removal of the gall-bladder with cystic duct drainage and (providing she survived that) a secondary operation on the common duct.

A review of these data makes it appear that—

1 *Age* cuts little figure as a determinant of fatality. True, the majority of those who died were over fifty while the majority of those who recovered were under fifty years of age, but it must be noted that, of the whole series operated upon for common duct obstruction by calculus eight over fifty years recovered (one of seventy years) and four cases over fifty years died (one of 68, one of 72).

2 *Sex*, however, cuts a striking figure. Out of twenty-two operations on women, four were fatal (18 per cent), while five of the eleven men operated upon died (45 per cent).

3 *General condition* of the patient also seems to be important. Seven of the fatal cases were in bad condition from chronic alcoholism, chronic nephritis, chronic pancreatitis. Two were in fair condition at the time of operation. All but four or five of the twenty-five recoveries were in fair or good condition at the time of operation.

4 *The Duration and Severity of Symptoms*—Signs of the disease had been noted for seven years (on the average) in the fatal cases and for an average four years in those that recovered (if we omit one case of thirty years' standing, which raises the average to six years). The immediate severity of the symptoms of pain and jaundice, however, do not seem to have definitive value.

5 *Time of Operation*—Stage of the disease. Six who died were operated during symptoms of acute infection. The three others were interval operations. Only six or seven of the recoveries were operated during acute symptoms.

6 *Length and Difficulty of Operation*—Six were long and very difficult. Three presented no unusual difficulties. This factor seems by itself to be in most cases of secondary importance, for many of the successful operations were apparently as long and difficult as the unsuccessful ones. In all there were five transduodenal operations. Only one was fatal.

7 *External drainage of the common duct* was practised in all but one of the fatal cases and in all but three of the recoveries. These four were transduodenal operations with splitting of the papilla of Vater and dilatation of the duct to secure adequate internal drainage.

8 *Complications* appear to be of the utmost importance. Four of the fatal cases had definite signs and two others had signs suggestive of pneumonia. Two had well-marked chronic pancreatitis. Two had tuberculosis, one pulmonary, one peritoneal. Two had chronic nephritis, three had peritoneal abscess and one had myocarditis.

Among those who recovered there were several whose convalescence was complicated by wound infection or chronic sepsis and one each by an acute exudative pleurisy on the twenty-third day and by an acute suppurative cholecystitis on the forty-fifth day after operation, but it is notable that none of those twenty-five who recovered had shown signs of pneumonia, while six of the nine who died had shown them. And whether they died with or of pneumonia this complication must be regarded as a frequent determinant of fatality.

To recapitulate then, we find that in this series (1) sex, (2) general condition of the patient, (3) the length of time that he has had the disease, and (4) the stage of the disease (acute or interval) in which he is operated are all factors bearing upon the mortality of this operation, but that complications pre-existent to, concurrent with, or consequent upon the patient's biliary obstruction are the chief factors in determining a fatal outcome of the operation for its relief.

Is there a remedy? Can we do better than we have done with the cases—as we get them?

Upon the number and severity of the pre-existent or concurrent complications we can have no effect unless by persuading the medical men to turn over gall-stone cases earlier to the surgeon. There is so much importance in this consideration that one hardly considers it hyperbolic to say that, in the final analysis, many of these cases die of delay, as they used to with appendicitis.

Over the complications consequent upon operation we may perhaps exercise some control. Pneumonia in our experience is the chief among them. Now, the incidence of pneumonia, like all other bacterial diseases, is due to a lack of sufficient resistance to infection and its fatal outcome depends upon a failure to develop immunity. Whatever we do, therefore, to increase the patient's resistance, and whatever we refrain from (with a similar purpose) may probably lessen the frequency with which this complication appears.

Since even the strongest person in the healthiest possible condition can be killed by operative procedures sufficiently mutilating and prolonged (as was frequently proven in the days of the Inquisition), and since a sufficiently large dose of ether is lethal to the most resistant individual, it is plain that the least extensive and the most rapid operation (within limits of necessity) and the briefest and best administered anæsthesia will lay the lowest tax upon our patient's resistance and best conserve his possibility of acquiring immunity, not only against his existing infection but against others possibly in prospect. These are things that every surgeon knows. But he is liable occasionally to forget them.

Interval operation, of course, represents operation during the positive phase of the patient's immunity procedure, and is therefore desirable. But, and there is a necessary emphasis on this, it is not always

possible to tell whether there is going to be another interval to follow the attack we are observing

In such cases as this I believe that it might prove a life-saving measure to restrain a very natural desire to do as complete an operation as possible, and practise, instead, a mere drainage of the abscess, if there be one; or a simple drainage of the common duct, in its upper part, leaving the attempt at complete removal of all obstructions till a later time, when the patient, if he lives, will have acquired greater resistance to meet the greater demand upon it which prolonged operative procedure brings

And, finally, having examined the evidence as carefully as it could be examined, after the fact, and having weighed it as impartially as only one who has done none of the recorded operations can weigh it, I am glad to believe that (with the possible exception of three cases, A268, B1873 and B4449) the mortality in this particular series would have been no lower in other hands than ours. And I have to thank the men who did these operations for their courtesy in permitting me to report them

# THE ETIOLOGICAL RELATIONS OF THE SEQUELÆ TO GASTRO-ENTEROSTOMY

TOGETHER WITH THE DESCRIPTION OF A SIMPLE OPERATIVE TECHNIC

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SOME fifteen years ago we were led, by the serious nature of the after-effects of the gastro-enterostomy, to institute animal experimentation for the purpose of clearing up the etiology of certain of these sequelæ, and, if possible, the simplification of the technic of operation and elimination of these troublesome phenomena

Early in the course of the work, the use of clamps for the juxtaposition of tissues was abandoned, and somewhat later we began using catgut to replace the non-absorbable materials then employed for sutures, with the most gratifying primary and secondary results

Numerous changes were made in the method of anastomosis until finally a simple and flexible technic was evolved. So gratifying, in fact, were the experimental results that immediately (in 1903) this technic was substituted in human surgery and the clinical records of some 140 cases operated by the new method with the use of catgut sutures are now available

## ANIMAL EXPERIMENTS

Beginning in 1902, at the Chicago Post-Graduate School and continuing at the Chicago Polyclinic and at the Illinois Post-Graduate School, some 5000 dogs were used in this work, with results now to be stated.

More than 150 dogs were subjected to long-loop gastro-enterostomies with the use of clamps and silk sutures. As it was not then our purpose to criticise the use of non-absorbable suture material, the operations being done entirely to investigate the etiology of sequelæ, the greatest care was observed to prevent too great constriction of tissues—only sufficient force being used in tying the sutures to prevent leakage and secure the necessary apposition. Also, there was no unnecessary traumatization by the clamps.

Of this series, 20 per cent died within two days, practically all with symptoms of obstruction. They were immediately examined postmortem and histological investigations made. On opening the abdomen, it was found that kinking of the long loop had been the principal cause of the difficulty, and that much of the abdominal



contents was already more or less completely involved in a plastic exudate. The gastro-intestinal junction was explored, the patency of the stoma was demonstrated, and in some cases portions of tissue were subjected to microscopical examination. The appearance of the tissue immediately surrounding the stitches led to the discovery of considerable infiltration with lymphoid cells. The gastric and jejunal mucosa showed, in over 60 per cent of these animals, hemorrhagic spots or ecchymoses. One dog undoubtedly died more as a result of hemorrhage from the edge of the operative wound than from a partial obstruction also present. This was the only case in which hemorrhage from the wound happened.

The remaining dogs were killed and examined after intervals of from thirty to ninety days. Many had not recovered from the operation, in fact, the mortality from the tenth day to the time of killing had been about 6 per cent. Autopsy showed varying degrees of obstruction in more than 30 per cent, this being due, in 26 dogs, to distortion of the lumen of the efferent loop by tension of attached adhesions. One dog showed definite tissue proliferation at the gastrojejunal anastomosis, forming a flap which had presumably acted as a valve obstructing the efferent passage. This may have resulted partially from too tightly suturing the serosa, although the occurrence of such an accident is doubtful. In one case the stomach was found markedly dilated, but no definite cause for obstruction could be demonstrated. Here again minute examination of the mucous surfaces was made, resulting in the discovery in more than half of these animals of definite peptic ulcers of the jejunum, the ulcers varying from barely microscopic size to a diameter of 3 cm. They appeared most frequently in the immediate neighborhood of the artificial stoma.

These findings prompted us to repeat the operation on a few animals without using clamps. The results in this case differed from the previous only in the comparative absence of adhesions in cases surviving thirty to sixty days, ulceration of the jejunum was still a frequent finding.

The silk suture material was then replaced by chromic catgut, which was a little later abandoned for pyoktanin and plain catgut. The results were of such a nature that the work was carried on until some 4500 animals had been submitted to this and to modified gastro-enterostomies, always without clamps and using plain or pyoktanin.

The mortality following the long-loop operation was greatly reduced and, in some 2000 experiments with the technic to be described, we found a ten-day mortality of six-tenths of one per cent and a later mortality (excluding cases in which definite extra-operative disease caused death) even lower. Complete recovery from the effects of operation was witnessed in over seven-eighths of

all cases Autopsies, performed after from thirty to one hundred and twenty days following operation, demonstrated a general absence of adhesions, those occasionally encountered being confined to the immediate neighborhood of the anastomosis Careful examinations of the mucosa showed a notable absence from peptic ulceration, either at the gastro-intestinal junction or in the jejunum, in fact, ulcers were found in less than one-eighth of one per cent and these found were generally very minute and appeared only in cases on which an early autopsy (thirty days) had been made

Mechanical failure of the catgut sutures was never observed

From this work, the conclusion was reached that the use of clamps was very undesirable, in that, on the one hand, they caused trauma of a severe nature to the mucosa of the stomach and jejunum, a belief concurred in by Coffey, Sinclair White and Hamilton, and on the other hand, the serosa of both organs was injured to the extent of loss of substance and resulting plastic exudation of an extensive character with subsequent adhesion formation which later gave rise to much trouble, even frequently causing obstruction of the efferent loop The occurrence of this adhesion formation is commonly noted in the literature, one of a great number of illustrating examples being the case (upon which five operations were made) reported by John B Deaver in the *New York Medical Journal* <sup>1</sup>

The noteworthy frequency of peptic ulceration following the use of silk sutures and the almost total absence of this sequela after the catgut anastomosis convinced us that here was the etiology of this after-effect In fact, so completely were we convinced that catgut was ideal for this kind of suturing, that we began its use in human surgery in 1903, and have used it exclusively since, including more than 140 gastro-enterostomies, with mechanical failure in no case, without a single mortality from the operation or its after-effects, and without, since the introduction of our modification in the technic, a single bad result of any description

#### REGURGITANT VOMITING

Regurgitant vomiting, the so-called "vicious circle," has constituted at once the most frequently reported and the most eagerly investigated sequela to gastrojejunostomy The original methods of Wolfler (1881), and, in fact, all antecolic gastrojejunostomy methods have been almost entirely abandoned, now being advised only in case of dense posterior adhesions of the stomach and massive carcinoma involving the dorsal stomach wall and in cases where a congenital anomaly in the form of a very short mesocolon is found <sup>2</sup> This is owing largely to their great liability to this complication Theory has run riot in explaining this phenomenon—the passage of time has seen the partial overthrow of every theory so far advanced The literature is replete with modifications of

technic intended to obviate this difficulty, yet we still find it occurring occasionally after every form of operation so far used

One point is especially worthy of discussion, viz The relative infrequency of regurgitant vomiting following the use of the Murphy or other button, a fact noticed by almost every surgeon of large experience in this work We have here the chief argument in favor of the "valve hypothesis," the explanation by the supposition of tissue proliferation or folding at or near the gastric attachment of the efferent loop, acting either by obstruction of the flow from the afferent to the efferent loop (Lauenstein, Braun and Jaboulay), or obstructing the outflow from the stomach into the efferent loop while the afferent loop remains patent and receives the gastric contents To prevent this supposed difficulty, the modifications of Kocher, Hadra and Lauenstein (valve or spur formation by the surgeon in the mouth of the afferent loop), of Littlewood and Moynihan (construction of the anastomotic opening of the afferent loop), of Chlumsky (twisting of the afferent loop through an angle of  $180^\circ$  before gastric attachment), of Mayo, Lauenstein, Braun, Jaboulay and others (entero-anastomosis), of Wolfler, Chaput, v Hacken and Fowler (constriction of the afferent loop) and of Doyen (division of the afferent loop) have been recommended and in turn found wanting in certain cases

To prevent mechanical kinking of the bowel, surgeons have gradually changed from the antecolic to the retrocolic route and from the long-loop posterior operation to the "short-loop" and "no-loop" methods, yet still we find regurgitant vomiting reported, —happily, with growing infrequency, this bearing out, to some extent, the doctrine of Terrier, that vicious circle is due to faulty technic

One fact has been fully demonstrated, *ie*, that the flowing of the duodenal juices into the stomach is not in itself a sufficient cause for vomiting, much less, for vomiting of such severe nature as occasionally follows the operation We here refer in part to the work of Dastre and to the well-known case of Moynihan in which the afferent loop was totally obstructed so that the bile and pancreatic secretions were forced to pass through the stomach to reach the anastomotic opening, but more especially to the clinical reports of Paterson,<sup>8</sup> who detected bile in the stomach contents of 73 per cent of all his gastro-enterostomy patients

Two cases upon which we performed secondary operations (the first operations having been done elsewhere) showed the cause for recurrence of symptoms to be a partial obstruction of the efferent jejunum by the tension of very dense adhesions In both cases, the gastric stoma was found patent and of sufficient size The adhesions were destroyed and the patients thereby relieved of symptoms of gastric difficulty

JEJUNAL ULCER

Notwithstanding the supposed rarity of jejunal ulcer following gastrojejunostomy, it is the belief of the author that many of the "improved, but not cured," cases are directly referable to this sequela. V. Eiselsberg<sup>4</sup> saw peptic ulcer in only 7 out of 317 gastro-enterostomies, but expressed his belief that they were not the entire number. Further, he emphatically agrees with v. Huberer in stating that jejunal ulcer is a very serious condition. Moreover, when one considers statements like that of Willy Meyer<sup>5</sup> in which he reports a case that, "In spite of his apparent good health, however, as far as gastric symptoms were concerned, he had on at least three occasions had tarry stools—but without pain," and the findings of Paterson,<sup>6</sup> who considers 52 cases of definite jejunal ulcer and 9 doubtful cases collected from the literature, of which, in every one of the 52 definite cases, the ulcer was shown to have perforated the bowel, one cannot but believe that any except severe cases are reported and these not invariably.

The results before stated in the animal experimentations when silk was used for suturing were such as to inspire a belief in the frequency rather than in the rarity of this complication.

Based upon the histological examinations, a conclusion was reached that these ulcerations were primarily caused by focal necrosis following inflammatory reaction in the neighborhood of the introduced foreign bodies (silk sutures) and by infarcts of the mucosa due to circulatory disturbances caused by inflammatory thickening, where they could not be traced directly to trauma and hæmatoma formation.

The recent work of Rosenow may offer yet another explanation if the supposed existence of a septicæmic infection as the cause of gastric and duodenal ulcer be accepted, for a foreign body present for a long time may so reduce the normal resistance of adjacent tissue as to lead to the formation of local foci of infection. However this may be, the statement of Wm. J. Mayo, that in three cases of gastrojejunal ulcer, one was due to an impacted Murphy button, one to an infected stitch, and one to a hæmatoma, is clearly pertinent to our hypothesis.

Schortak<sup>7</sup> examined 34 cases of peptic ulcer and found 18 below the site of the gastro-enterostomy, 15 on the margin of the gastro-intestinal anastomosis, and 1 in the margin of the entero-anastomosis, facts in no way refutatory to our assumption.

PREMATURE CLOSURE OF THE ARTIFICIAL STOMA

Occasionally the new mouth has been observed to close and obstructive symptoms then result. The relation of the Murphy button to this phenomenon has already been mentioned. V. Eiselsberg<sup>4</sup> declares that closure or reduction in the size of the gastro-enterostomy opening is due practically always to peptic ulceration,

although closure of the pylorus in the course of the primary operation has been recommended as a preventive measure, based on the work so well summarized by Guibe,<sup>8</sup> who reviews the experimentation of Blake and Cannon, Leggett and Maurey, Kellog, Dilbert, and Tuffier, and adds original work supporting the conclusion that in the presence of a patent pylorus " nothing whatever passes through the new opening, on the contrary everything passes through the pylorus "

Henri Hartmann<sup>10</sup> criticises the above authorities, and, agreeing with Calabrene, cites radiographic observations to support the conclusion that " the gastro-intestinal anastomosis may (and does) work even in cases where the pylorus is patulous "

J M T Finney<sup>11</sup> saw a case in which, in the face of an absolute pyloric stenosis, the gastro-enterostomy opening had been reduced to the size of a straw

Especially worthy of note by the interested physician is the article by Scruger,<sup>9</sup> published in 1914, in which remote results of these procedures are discussed. The author believes with Scudder<sup>12</sup> that pyloric closure is far better to be considered as a secondary operation when results show it to be necessary, rather than as a part of the primary procedure

#### OPERATIVE TECHNIC

The hand is placed on the anterior stomach wall, with the omentum and transverse colon gathered up between the thumb and forefinger (Fig 1) pushing the stomach against the mesocolon

The mesocolon is now opened with a blunt forceps, and the tear extended until an elliptical opening about two and one-half inches long (Fig 2) results, the edges are then attached to the posterior wall of the stomach by four stitches, the end stitches being left long and used as temporary guides (Fig 2)

If the mesenteric attachment of the bowel is far enough to the right, bring the bowel straight up in prolongation of the duodenum (Fig 7), if not, turn the bowel from left to right (Fig 2), otherwise a kink at the duodenojejunal junction will result, with the probability of obstruction

The bowel is now brought up into juxtaposition with the stomach and guides placed at each end, the first guides being now cut. An over-and-over Lembert suture is then used (Fig 3)

The assistant now exerts steady traction upon the guides, thus preventing leakage, and the stomach and bowel are opened. The same suture is used to whip over and over with a through-and-through stitch, so as to coaptate the mucous surfaces (Fig 4)

With a Cushing stitch, the anterior stomach and bowel walls are coaptated (Fig 5), and the operation finished with a Lembert suture, making two rows of sutures all the way around (Fig 6)

Number 1 pyoktanin catgut is used exclusively, as has been the case for the past ten years

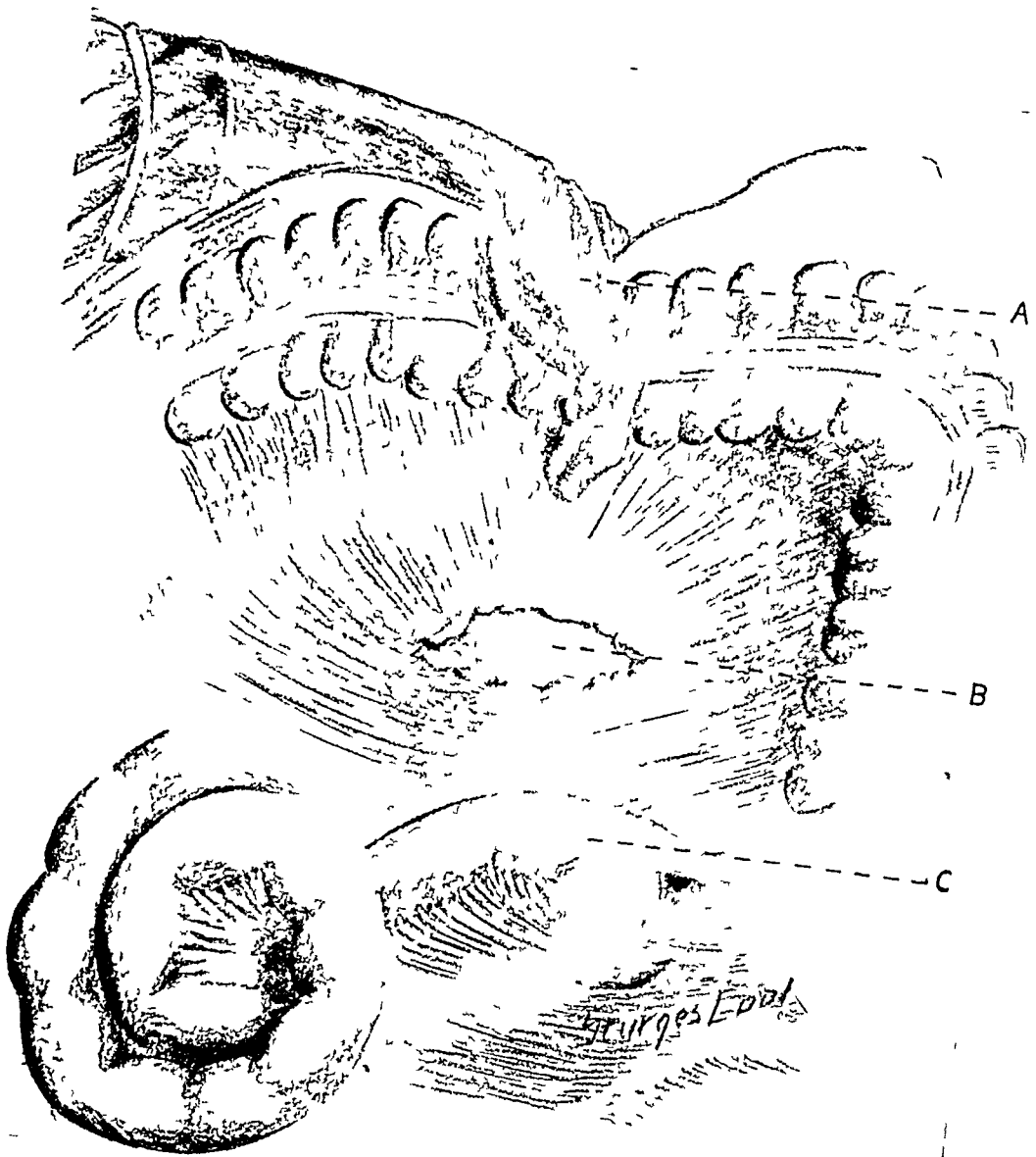


FIG 1—4, hand over omentum and transverse colon, *B*, stomach wall showing through incised mesocolon, *C*, jejunum

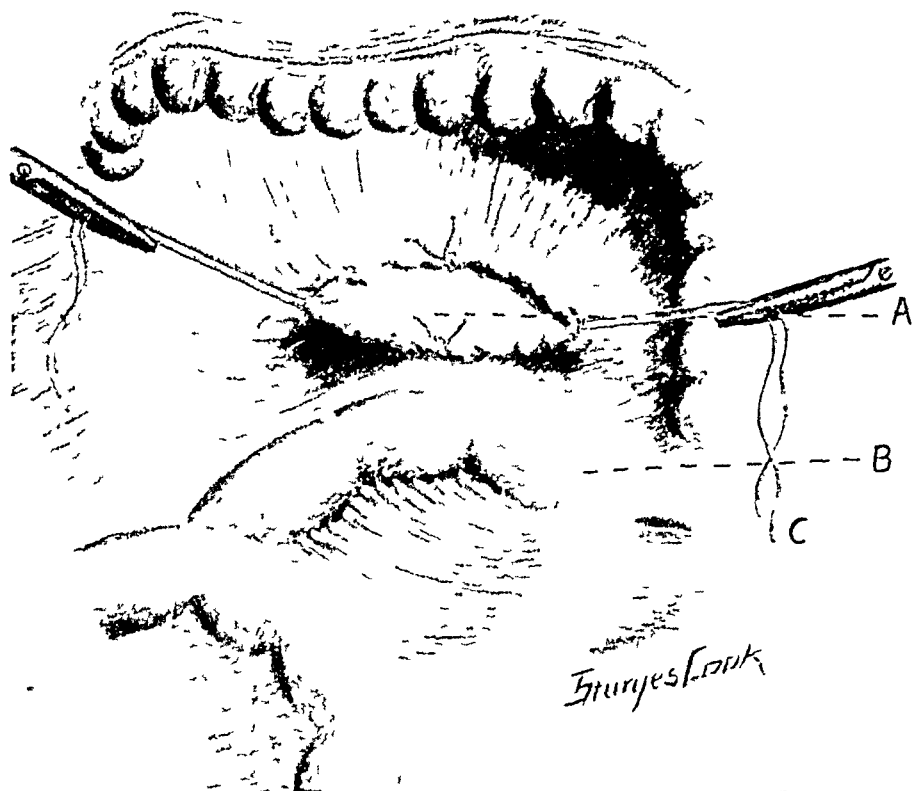


FIG 2 —A, wall of stomach, B, jejunum, C preliminary guide ligatures

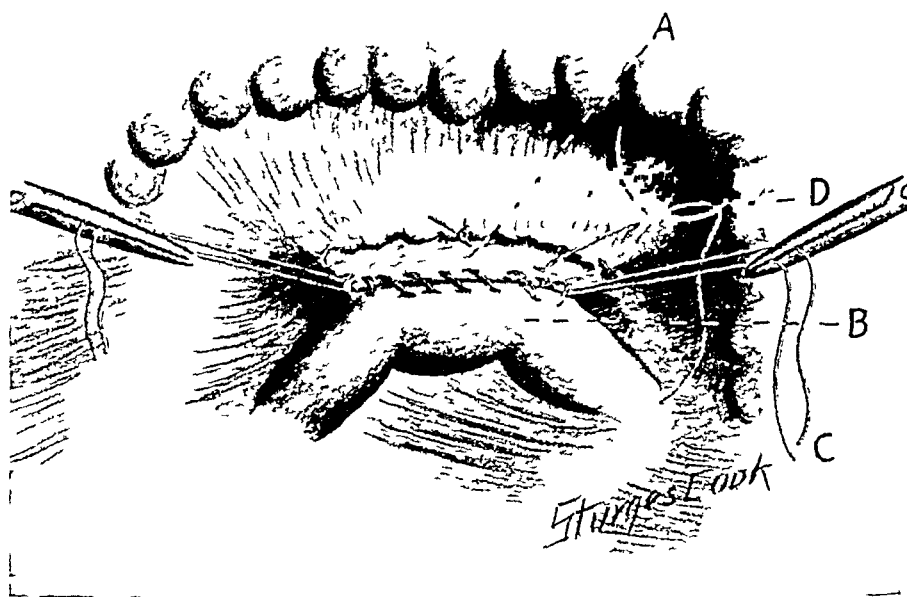


FIG 3 —A stomach wall, B jejunum, C guide ligatures, D catgut used as first row of sutures

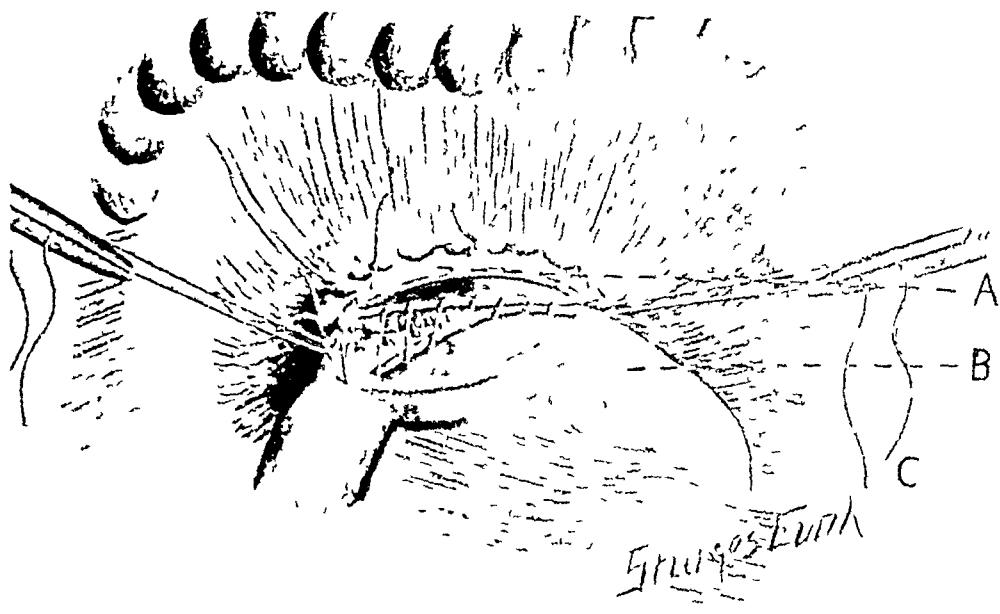


FIG 4 — A, incision in stomach wall, B jejunum, C, guide ligatures

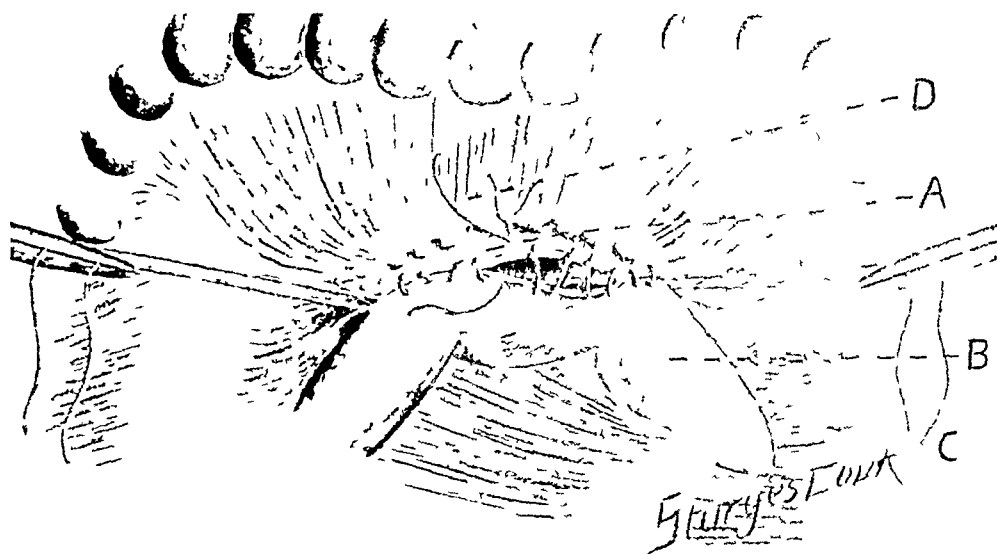


FIG 5 — A, surface of stomach, B, jejunum, C guide ligatures, D, catgut sutures



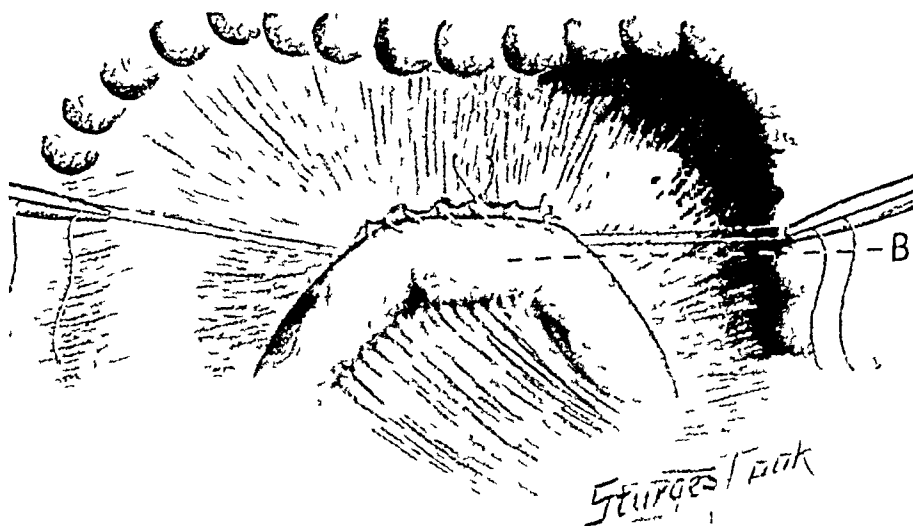


FIG 6 — 1, wall of stomach, B, jejunum

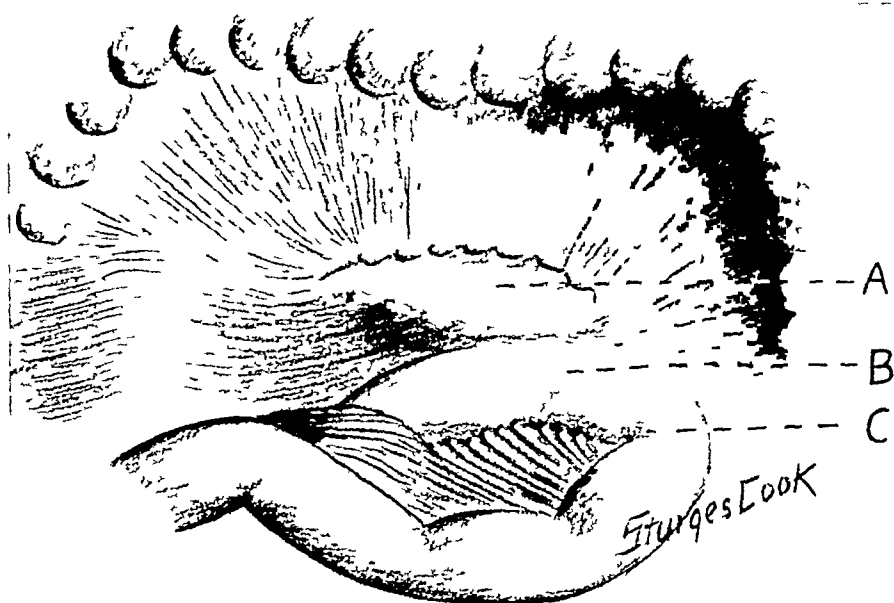


FIG 7 — A, wall of stomach, B, section of jejunum to be attached to stomach when duodenal jejunal junction is sufficiently far to the right C section to be used under other circumstances

## SUMMARY

The described operative technic offers the following points of interest to the surgeon

1 If a laparotomy is made and pathology is discovered in the stomach, this form of gastro-enterostomy may be made at once

2 Less assistance and no special clamps are necessary, of such nature is the procedure that it has been successfully performed upon a kitchen table in a town far removed from hospital facilities

3 It is more adaptable than the clamp method, being suited to the field of operation rather than the field being adjusted to the surgeon and his clamps

4 In certain carcinomatous conditions of the antrum of the stomach and where there are present large posterior adhesions the posterior gastro-enterostomy with clamps becomes impossible, yet this operation may still be performed, as a large field is not necessary

5 Tension on the guide sutures eliminates any danger of leakage and resulting peritonitis as effectively as does the use of clamps

6 Uniform approximation of the tissues Greater ease of introduction of the sutures, and less danger of too great tension being used in tying the sutures results from the absence of the discretion of anatomical structures and relations produced by clamps

7 Greatly decreased degree of local trauma, and resulting reduction in the liability to adhesion formation, a point, by the way, which has led Hartwell of New York to abandon the use of clamps

8 Marked reduction in disturbance of the sympathetic nervous system and resulting shock or atonic dilatation of the stomach, as the stomach wall is dragged far less than is necessary to secure sufficient tissue between the clamps

9 Practical impossibility of hæmatoma formation, because of the absence of bruising by the clamps and increased facility in locating bleeding points

10 The very short period during which foreign substance remains in the tissues, this reducing the liability to necrosis and ulcer formation

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# POST-OPERATIVE PARALYTIC ILEUS

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ILEUS has been defined as a retention of the intestinal contents I wish at once to make a clear distinction between ileus from a mechanical obstruction and ileus from a paralysis of the musculature of the intestine; in this paper I will deal only with the latter, and the two must not be confused with each other Paralytic ileus is wholly a retention from complete muscular atony and not from an organic obstruction, yet many authors will speak of a paralytic obstruction In this there is no onward movement of the intestinal contents and no attempts at the same, therefore, there can be no obstruction unless something is being prevented from passing on However, McLean claims that the clinical picture is the same in both conditions, with this we cannot agree, as our observations have shown them to be most unlike clinically This will be described more fully later on

This serious post-operative complication has not received the attention it deserves Although much has been written upon the subject, it is really not well understood and we believe not recognized readily by us Relatively little is known as to its etiology and there has been but little research work upon the subject, and what has been done has been mostly to determine the cause of death, by showing which portion of the intestinal secretion and contents were more poisonous, however, the research has been of distinct therapeutic value We know better what to do in case it arises than we do what causes it or how to prevent it Our text-books are peculiarly silent upon the subject or have it jumbled up with all kinds of mechanical intestinal obstruction

There is a certain amount of paralytic ileus after every abdominal incision as is evidenced by the usual accumulation of gas with which we are familiar and which gives us no grave concern

*Occurrence* —It may occur after any abdominal operation or even after only the administration of an anæsthetic, however, it is said by some to occur more frequently after certain operations, *e g*, after resection of the omentum, rough handling of the intestines in any operation in the abdomen, or following an operation for relief of volvulus or intussusception, where the mesentery is more or less injured Lack of pelvic drainage is claimed by Mr Hicks as a causative factor The same author says that it has occurred in his practice five times in three hundred abdominal operations, in my own experience it has occurred four times in approximately seven hundred operations Rather oddly it has occurred to me three times in the last year, and I trust

that now the rather fateful occurrence of serious or odd things happening "three times in succession" has been satisfied and that I may be spared this perplexing complication for some time again

We believe very firmly that this condition is often incorrectly diagnosed as an acute dilatation of the stomach and treated as such, and in its later stages for a general peritonitis

It may involve either the whole intestinal tract, only the upper portion of the small intestine, only the large intestine, or only the lower portion of the small intestine, but the more common site is the jejunum or upper portion of the jejunum

*Etiology*—There is little definitely known as to its etiology. Some claim that it is always due to a rapidly spreading peritonitis or to a localized peritonitis. This is hardly reasonable, as it occurs fully as frequently after clean operations as after pus cases. McKenna thinks it is due to a disturbance of the innervation through the splanchnic nerves of these certain portions of the intestine. This is true, but he cannot offer explanation of the factor producing the disturbance, other than it is due to the absorption of certain toxins. At any rate, it is a peculiar response, an idiosyncrasy, so to speak, from the shock occasioned by either infection or trauma from the operation. This is my own suggestion, but it cannot be really an explanation, because we do not know why an idiosyncrasy does occur.

In general peritonitis we have a paralytic ileus and the etiology here is very evident, but we probably cannot reason from this that it is always caused by a peritonitis of some type.

*Diagnosis*—Onset is usually within thirty-six to sixty hours, with a mild distention in the upper abdomen, usually, and has the appearance now of a slightly dilated stomach. It is without pain all the way through and without shock until later in its course. It has a peculiar, soft doughy or "gassy" sensation upon palpation, which is increased and very marked later on as the belly becomes more distended. Percussion may show a varying dulness and gaseousness with changes in position, due to both fluid and gas in the intestine, this has been referred to as a "pseudo-ascites." It may be that more or less gas has been passed with enemas previous to the onset, this comes from the lower unparalyzed portion of the gut. There is usually no particular rise in the temperature nor in the pulse in the early stages, but later the pulse always increases and the temperature usually, respirations are normal in the beginning and increase as the pressure from below embarrasses both lungs and the heart. The patient himself always says he feels fine even when death is impending. One of my patients demonstrated this most remarkably when I entered the room forty minutes before death, I spoke as cheerfully as I could, "Well, Charles, how are you feeling?" He answered at once, quickly and brightly, "Feeling just fine, Gee" (calling me by my college nickname), yet the whole appearance was that of impending dissolu-

tion, to me, yet, the cheerfulness of this remark remains as being almost uncanny. I wish also to offer, as a diagnostic sign in this condition, my observation in each of my four cases, namely, a peculiar complacent appearance of the face amounting to a sort of kindly, benignant expression, such as is sometimes seen upon the faces of elderly phlegmatic persons, this in contradistinction to the hippocratic facies of general peritonitis and in mechanical obstruction of the bowel, where they are suffering great pain from the peristaltic wave. There is usually a gulping up of bile-stained fluid early and the stomach washing relieves this only for a short time, often requiring several gallons of soda solution before it is returned clear, in fact, in one case I used as much as seven gallons in one washing and even then the fluid was not clear. Vomiting is without pain and nausea.

One is often fooled by the unalarming appearance of the patient and may be lulled into a false sense of security by this, for the critical stage is reached so gradually that you can hardly realize that death is impending, for, as mentioned above, the mental condition may remain normal, and, at most, there is little more than a mild delirium. I think this is most unfortunate, for it almost urges us to delay suggesting more radical procedures, and I might interpolate here that I regard this condition as one not only requiring but demanding immediate operative, mechanical relief. This is certainly no place for the timid surgeon or internist who calls procrastination by the soothing term "conservatism," the emergency is present and your patient's life depends upon relief from the poisons retained in the upper intestine, and it is no time for you to consider what the relatives and friends will think of your ability or whether they will criticize you in advising another operation. It is something that you owe to your patient and to your profession to refuse to consider the possible effect upon your standing, but to offer him perhaps only a gambler's chance for his life.

*Differential Diagnosis*—(a) Ordinary post-operative gas distention. In this condition there is always pain, there is no gulping, there is tenderness always over the whole abdomen, the distention does not markedly increase, pulse-rate may be slightly increased.

(b) General peritonitis. Here pain and tenderness are usually present, temperature is increased, pulse is rapid and perhaps weak, temperature usually precedes the distention, hippocratic facies present, vomiting is preceded by other important symptoms of temperature, rigidity, pain, etc.

(c) Mesenteric thrombosis. Practically the same as in acute intestinal obstruction.

(d) Acute intestinal obstruction. From records of thousands of cases of acute intestinal obstruction, pain is a constant symptom in the early stages, coming on intermittently, tumor mass often present, peristalsis often observed, especially through thin belly walls, vomiting is forcible and not a gulping, may be blood by the bowel, distention is

very much less marked and rigidity and tenderness is always present

From the above and from my own observation I cannot see any marked resemblance between paralytic ileus and any of these other abdominal conditions, except acute dilatation of the stomach, notwithstanding the assertions of other men, and certainly to me there could be confusion only with a dilated stomach from the clinical findings. It is my opinion that the differentiation can be made exact only with the X-ray, with a small amount of bismuth in the stomach. The X-ray is always advisable in either paralytic ileus or acute dilatation of the stomach, and clinches the diagnosis by demonstrating the enlarged stomach or the distended loops of the small gut sometimes as much as three inches in diameter, as shown in two of my cases, one of which came to autopsy. I further feel very sure that a good percentage of the cases diagnosed clinically as dilated stomachs are paralysees of the intestine. This was quite certainly demonstrated in one of my cases in a ward at St. Joseph's Hospital. I invited several of the surgeons and internists in to see this case, and all of us, with the exception of Dr. Arneill, called it stomach. As I, too, had called it stomach and treated for same, I had an X-ray taken with some bismuth in the stomach. This organ was crowded up high into the diaphragm and not dilated and the immensely distended small intestines filled the entire belly cavity. This plate I showed at a County Hospital Staff meeting last year in connection with Case II reported below.

*Cause of Death and Morbidity*—Bonney<sup>4</sup> asserts that the fatal results are due to toxic absorption from the upper intestinal tract, brought about by the ascending infection of *Bacillus coli communis* and other organisms of the lower gut in a state of exalted virulence and activity. This view is held by many men. Kelsall<sup>5</sup> believes the cause of death is due to the loss of fluids with consequent drop in blood-pressure and resulting cerebral anæmia, with the upward pressure upon the heart and lungs and with toxæmia. Andries<sup>6</sup> also believes that the critical symptoms and death are due to loss of body fluids, and Hartwell and Hoguet have demonstrated experimentally that animals with experimental mechanical ileus can be kept alive almost indefinitely by the administration of quantities of saline infusions to replace the fluids lost. McLean refutes all these after producing experimental ileus upon animals, and asserts that it is either the secretions or the altered physiological relation of the secretions of the duodenal mucosa that produce both the alarming symptoms and death. He is upheld in this by the experimental studies of Whipple, Stone and Bernheim.<sup>7</sup>

My own treatment of the two fatal cases would certainly eliminate the loss of fluids as being a factor in death, for both were given large quantities of fluids and their blood-pressure remained normal until soon before death. To my mind toxæmia is the cause of death and

I do not believe that we can separate effects of toxins of bacterial origin and those of changed glandular secretions. One thing has been pretty well demonstrated, and that is, in retention of the upper bowel contents, from high obstruction or paralysis, the mortality is higher. This might add weight to McKenna's<sup>s</sup> idea of upset physiology in upper tract.

## REPORT OF CASES

CASE I—Mr E T N, aged forty-two, was operated by me August 19, 1912, for a very large right-sided inguinal hernia and a very large left-sided hydrocele. Operations were done at one sitting under local anæsthesia of novocaine. The patient being fat and so much omentum being in the hernia, I felt it was advisable to resect the portion of omentum which was in the hernia. This I did. On the second day the patient became distended in upper abdomen, which I diagnosed as a dilatation of the stomach and gave the usual treatment for the same, but he did not respond. We did not have the typical findings from the stomach washing, but a number of my surgical and medical friends, ten in all, saw him and all but one diagnosed acute dilatation of the stomach. I then had an X-ray taken by Dr Stover with a small amount of bismuth in the stomach, and we found that the stomach was normal and the small intestines were enormously dilated, even as much as three inches in diameter. This patient's condition remained good, and he did not pass gas nor fæces until the tenth day, however the distention was the same throughout and I feared it would prevent the hernia from properly healing, but it did not, nor did the wound become infected. The medical treatment described below was used here after the proper diagnosis was reached. To me this is a most astonishing case—this man's abdomen was as large as a tub, but his mental condition remained normal and he joked with the other ward occupants about the size of his belly.

CASE II—Mr G, aged seventy-two, County Hospital January, 1916. Operated under local anæsthesia for a very large inguinal hernia. This hernia contained probably not less than ten or twelve feet of the small intestine with cæcum and appendix, the bowels were entirely empty, as he had undergone preparatory treatment for the operation. On the third day he was distended evenly over the entire abdomen, no pain nor tenderness, some gulping of fluid, but did not become stercoraceous at any time, the pulse and temperature were only slightly elevated, no hippocratic facies. He was treated by hot stupes and pituitrin, with many gas enemas, and when results from the enemas were evident, cathartics were given. Patient made an excellent recovery, nor was the healing of the wound interfered with.

CASE III—Mr C A was operated for appendicitis. The appendix was retroperitoneal and lying high in the abdomen, in fact, the tip of it was posterior to the second portion of the duodenum, and was removed with much difficulty. He was given

## POST-OPERATIVE PARALYTIC ILEUS

ether and took it badly, having to be resuscitated during the operation. His condition, however, was good the next day and also the second day, when the distention began to appear in upper abdomen. He was given gastric lavage, pituitrin and salt solution under the skin, lavage was continued right straight through at regular intervals day and night, but rarely did we get the fluid to return clear, even with as much as seven gallons of soda water, large amounts of stimulants were used, as the heart became rapid and weak. The patient's mental condition remained clear until the end, except for slight delirium, but he would talk normally when spoken to, even until a short time before death, which occurred five days after the appendectomy. A post-mortem examination was made and the stomach was normal in size, also the duodenum, the jejunum and all of the ileum except the last forty inches were distended to about two and one-half to three inches in diameter; the lower ileum and colon were normal, there was no obstruction to the gut anywhere, and the line was abrupt and definite between normal and dilated ileum.

Consultation was held with four doctors and surgeons and a jejunostomy was proposed, but thought then to be too late. I made up my mind from that case that I would not trust to medical measures in the future even though I had been successful in Cases I and II by non-operative measures.

CASE IV—Mr. R., aged forty-two, referred to Dr. Horace Heath, was operated for a ruptured appendix, under novocaine anaesthesia. Patient was in excellent condition until evening of the second day, when there was a mild painless distention in upper abdomen, no increase then of either temperature or pulse. Patient said he never felt better. The distention increased gradually with slight increase of temperature and pulse, some fluid was gulped up, stomach washed and fluid returned clear. On the third day his condition was worse, and we did an anastomosis between a dilated portion of the jejunum, which later proved to be about five feet from its beginning, and the sigmoid. This operation was also done under novocaine, and that night and the next day a good quantity of brownish material and gas was passed by the bowel. A suture, side-to-side anastomosis was made. We did this in order to not have a fecal fistula upon the surface, feeling also that it would make the later operation less difficult. We debated whether we should put in tubes from the rectum through the anastomosis, but did not, notwithstanding the passing of several pints of fluid from the bowel, the patient got steadily worse, and death seemed certain upon the fifth day, when we decided to again open the belly and bring a loop of dilated gut to the skin. This was done while the patient was practically moribund. We drained off a very large quantity of gas and brownish fluid by changing his position upon the table, it was a sort of last chance with nothing to lose. The patient died two hours later. A post-mortem examination showed the first anastomosis in excellent position to drain the upper jejunum and I



believe that a Murphy button anastomosis would have done this probably better than a suture. There was no peritonitis to be demonstrated at this time. The upper gut, practically only the jejunum, was dilated, as was shown by an X-ray taken on the third day and proved at post-mortem examination. The blood-pressure in this case remained normal until a short time before death, the pulse was rapid and weak the last twenty-four to thirty-six hours. I have one keen regret in this case, and that is that we did not bring the loop of gut to the skin at the time of anastomosis.

CASE V—Mrs J A K, referred by Dr Robert King, aged twenty-four, married, was pregnant two months when she instrumented herself to induce abortion which was accomplished three days before I saw her, condition now one of general peritonitis in desperate condition—Hippocratic facies, temperature  $103^{\circ}$ , pulse 121, respirations 28. Consultation was had with Dr I B Perkins and we decided that the abdomen should be opened and drained. This I did, found a general peritonitis with considerable involvement of the appendix, which I removed. She then went along fairly well and looked as though she would recover, this was at the end of about a week. She then began to distend markedly in the upper abdomen. At this time I left the city for a week, but advised Dr James A Philpott, my associate, that he would probably have to drain the jejunum, this he did later, assisted by Dr J F Roe. At operation it was found that the jejunum was dilated to approximately four inches in diameter. A loop was brought to the skin and opened and drained from both directions. She was immediately relieved of the distention and again in a few days it seemed very favorable for her recovery, however, on the seventeenth day she began to lose ground and died on the twentieth day from a general septic condition. In none of the wounds did healing proceed satisfactorily. A post-mortem examination showed some very interesting facts—the jejunostomy was found to be four and one-half feet from its beginning, the abdomen was filled with adhesions of the loops of the intestines throughout, all the gut below the opening was of normal size and normal in all ways except for the adhesions, no definite point of obstruction could be demonstrated, above the opening was found a most interesting condition. All except ten inches of the intestine had reduced to normal size and appearance, this ten-inch portion was fully four inches in diameter in half its length and the balance about two inches in diameter. Thus it is seen the drainage did really produce a recovery in the immensely distended jejunum, thus proving the efficiency of jejunal drainage in this condition. Just why the one portion did not recover I cannot offer an explanation.

*Treatment*—(1) Medical. The usual treatment for post-mortem gas should be instituted early, including enemas, hot stupes to belly, eserine 1/100 to 1/50 gr, pituitrin 1 c c each hour for three or four,

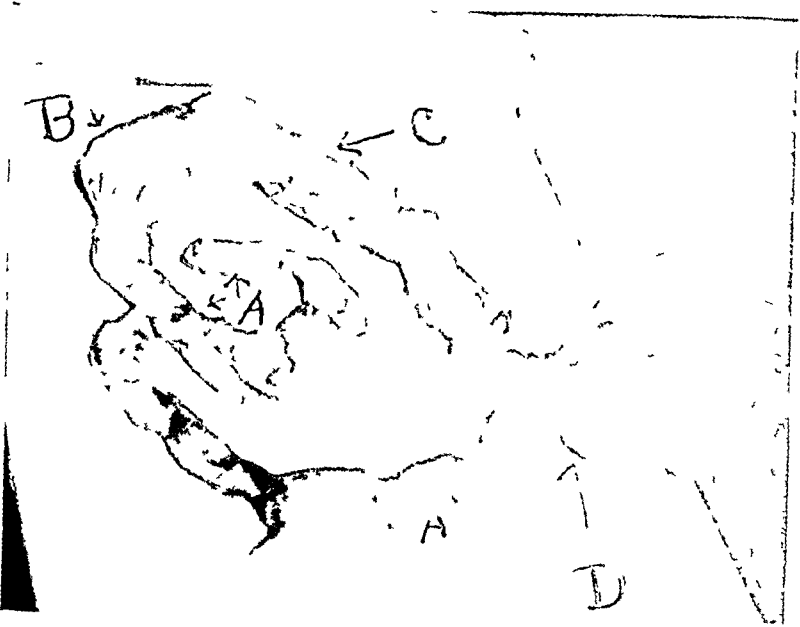


FIG 1—Post-mortem specimen of Case V. A, normal jejunum above and below the jejunostomy, B, the large remaining dilated portion, four inches in diameter, C, a portion two inches in diameter, D, the point of jejunostomy with a tube in each direction



hours at occasional periods, unless it has a bad effect upon the heart. Goth recommends physostigmin salicylate 1/64 to 1/32 of a grain, digitalin minims 15 each three hours and strychnine grain 1/30 to 1/15 each three hours, and caffeine sodium benzoate grains 11-111 each three hours, these last three alternating one each hour to support the heart. Cathartics are useless and perhaps damaging, gastric lavage hourly or two or three hours, but the best of all is large quantities of water both by bowel and by hypodermoclysis, ten to sixteen pints each twenty-four hours. Bonney suggests adding one ounce of brandy to each quart of saline infusion.

(2) If the above medical measures fail to give relief within twelve to eighteen hours after instituting them, or if your patient should get worse in the meantime, then resort must be had to surgery without further ifs and ands, or a continued waiting policy. The paralyzed gut must be drained at once if one wishes to save the patient, and when we know that this operation was successfully done in 1787 by Renault, following the suggestion of Louis in 1757, and was later revived by Nelaton in 1840, we should not hesitate to undertake it for the want of sufficient precedent or for the lack of the stamp of age upon it.

As to the method of surgical attack, we have the choice of several procedures that have been done and advocated by various surgeons. We may do, as suggested and used by Thompson,<sup>10</sup> an anastomosis between any loop of dilated gut that we may happen to pick up and the ileum just before the entrance to the cæcum, and this combined with an appendicostomy or a cæcostomy, altogether, we think this entirely too large an operation to be satisfactorily used in these desperate cases. You may also do an anastomosis between any portion of the dilated gut and any portion of the large intestine, preferably, we think, the sigmoid. If the cæcum is dilated along with the small intestine, then you may do a cæcostomy as used by Victor Bonney,<sup>11</sup> but we believe that by far the best procedure to undertake is the easiest and simplest of all and will be more likely to get the patient over the present dangerous condition, and that is to simply bring a loop of dilated gut to the skin, endeavoring to get a loop as high as possible, for it is important to get drainage as near the duodenum as one can, for this has been aptly called, by Bonney, "the reservoir of toxicity," this measure is upheld by McKenna, Whipple, Bernheim, Stone and others, after the gut is brought to the surface and opened immediately after suture to the peritoneum, and a tube passed into the gut in both directions for drainage of both gas and fluids and also to irrigate the intestine with salt solution. McKenna says this operation should always be done under local anæsthesia and we agree with him. Bonney reports 100 per cent of cures in all of his five cases, and asserts "that no patient with fecal vomiting should be allowed to die

for the want of this operation Its effect in my cases has been remarkable, in all of them there has been an immediate cessation of vomiting, and all the patients have recovered”

This, of course, requires a later operation within a few weeks to correct the fistula You may be criticised on account of this later operation, but when one considers that a live candidate for a second operation is of so much more value than a patient dead for the want of a fistula of the jejunum, you will have little hesitancy in urging such an operation in these extremely serious cases Hicks claims that all one needs to do is to stir up the intestines in these cases and to wash out the peritoneal cavity

*Site of Incision*—The incision should be made upon the left side of the belly, as here you are more likely to pick up the jejunum within a reasonable distance from the duodenum, so that the “reservoir of toxicity” will be better drained

Recovery of the tone of the intestine comes on quite suddenly, within a few to several hours after operation, and in two of my cases treated medically, tone was regained completely in the course of several hours after recovery really began

#### CONCLUSIONS

(1) Exact diagnosis can be made only with the X-ray which should always be used in every case of suspected dilated stomach or intestinal paresis

(2) Operation must be done early to obtain the best results in this very serious complication

(3) Do the simplest, easiest and quickest operation, and it must be done under local anæsthesia

(4) The vomiting (gulping) and the pulse are the best guides to follow as to when to operate Do not be misled by the patient's statements “That he feels fine,” etc

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# FRACTURES OF THE DIFFERENT BONES OCCURRING IN THE GOLD MINING INDUSTRY

END-RESULTS AND ECONOMIC STUDY OF 311 CONSECUTIVE CASES

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In the September, 1915, number of the ANNALS OF SURGERY appeared a series of articles on fractures by Dr. Huntington, of San Francisco, Dr. Estes, Chairman of the American Surgical Association Committee on Fractures, and others, in which the statistics were taken from large hospitals of the country and in which they found the difficulty of following them up and giving the end-results.

The thought occurred to me at that time that an even more fruitful field for fracture statistics would be found in many Industrial Hospitals, and to that end I set to work to compile the cases which had been under my own care in such a hospital, and it has been no small task to run each case down.

In August, 1910, the Homestake Mining Company and its employes formed an *aid fund*, the employes contributing \$1 00 each per month and the company \$1,000 00. With this fund we are able to pay \$1 00 a day to the injured men for nine months or more and \$1,000 00 in case of death or \$800 00 if totally disabled. The company also furnishes free hospital and surgical services to the employe until he is able to return to work, and no man is discharged from service on account of injury. We take care of, on an average, about 100 cases a year. Fifty-five per cent of these work for the company. All of the cases except fractures of the skull were verified by a two-way X-ray from time to time during treatment and their return to work. In this way we are able absolutely to keep these cases under observation for months.

The object of this paper is not to take up one particular fracture, but all fractures as they came from day to day from the mine. This series commences August 1, 1910, and ends December 31, 1916, and I shall only report a few of the cases individually. All of the cases are acute, and are in our hands from one-half hour to one hour after the injury, and injuries requiring immediate amputation are not reported.

Out of 2,500 men employed about 1,050 are underground workmen. In looking over these statistics you will be surprised at the preponderance of fractures of tibia, fibula, and toes. This is explained by understanding the underground workings. From the shaft a tunnel is run out, a stope or room of large proportions is cut. The rock is shot down from the roof forming a large conical pile sometimes 100 feet in diameter and 50 feet high. The shovelers and car men work on the border of the base. As they work, moving the rock, the surface of the pile

slides down, the rolling rock catching the man's legs or feet, if he is not able to get out of the way fast enough. We find also that most of these accidents happen during the first two hours of the shift, and is explained by the men having a definite amount of work to do during the shift, of eight hours. If they can accomplish the task in six hours they can loaf two hours, consequently they rush their work at the first and are not careful.

These stopes are well lighted by large acetylene lamps, but even this is not sufficient to prevent accidents.

I will now report 311 cases of fractures as they came to us from the works. The tibia and fibula cannot be briefed without cutting out a good deal of the information.

## SKULL

Case No	Age	Time off, days	Vault	Base	Operated bone	Results
1	33	60	1		1 Frontal compound	Good
2	32	36	1		1 Frontal C C <sup>1</sup>	Good
3	32	21	1	.	1 Parietal C C	Good
4	33	19	1		1 Temporal C C	Good
5	38	19	1		1 Parietal C C	Good
6	36	29	1		1 Frontal C C	Good
7	36	29	1		1 Occipital C C	Good
8	34	21	1		1 Occipital C C	Good
9	31	110	1		1 Frontal, Nasal, Ethmoid, Malar C C	Good
10	26	38	1		1 Frontal, Ethmoid, Malar C C	Good
11	32	21		1		Good
12	25	35		1		Good
13	24	10		1	Meningitis	Died
14	30	308		1	Petrous Temporal	Good
15	30	6		1		Died
16	26	30		1	Frontal Ethmoid	Good

## MALAR BONE

1 case 30 days off

## NASAL BONE

5 cases 8 days average.

## LOWER JAW

Case No	Age	Time off, days	Vault	Base	Operated bone	Results
1		37				Good
2	19	59			Wired C C	Good
3		37				Good

## HYOID

1 case 9 days, median line

## VERTEBRÆ

1 case 7 days, spinous process

CASE XIV—July 28, 1915 G C, aged thirty. Was found in the mine unconscious. On examination small scalp wound on left temple, bleeding freely from left ear, fracture of petrous portion left temporal, semiconscious, restless, and bleeding for three days,

<sup>1</sup> C C is compound comminuted

## FRACTURES OF BONES IN GOLD MINING

then for a week profuse flow of cerebral fluid soaking the dressings Mental condition improved from day to day and allowed to go home in two weeks

A few days later we noticed he had a loss of coordination in walking, of a peculiar regular rhythmic zig-zag nature—three steps to the right, three steps to the left, as far as he walked alone, but by being held by the arm he walked straight He had nystagmus very marked This condition continued for four and one-half months when we sent him to Dr Shambaugh in Chicago, and on the second day before examination the zig-zag motion suddenly left He returned home and in a few days returned to work, but worked but part of one day, when the same trouble returned and continued for a month, when we were arranging to send him to a lower altitude and change of association The trouble suddenly disappeared He did not want to go but we sent him, and while away he would have normal days and then a couple of staggering days He came back and, after settlement with the company, went to work in May, 1916, without any more trouble until January 12, 1917 On that day he worked very hard and at the close of the shift he staggered very badly, nearly falling into a pit Since then he has been all right It has been diagnosed hysterical

CASE VI—February 6, 1915 S W, aged thirty Received a compound depressed fracture of the right frontal bone just in front of the parietal suture He was not unconscious The depressed fragment was removed February 15, late in the afternoon, he commenced having epileptic seizures and by midnight 30 were recorded, when we reopened the wound, slit the dura, passed a probe forward between the dura and brain, when considerable bloody fluid squirted out, redressed with drain No more spasms and he went on to perfect recovery It is now two years and no more epileptic seizures have returned

### CLAVICLE

Case No	Age	Time off	Operated	Results
1	61	48	Wired	Good
2		41		Good
3	46	69	Wired	Good
4	24	.		Good

### SCAPULA

Case No	Age	Time off	Operated	Results
1		23	Wing	Good

### RIBS

25 cases                  average days off, 33

### HUMERUS

Case No	Age	Time	u/3	m/3	L/3	Operated	Remarks
1	22	117				Amp fingers	Radial art cut off, gangrene of fingers

CASE I—May, 1911 B H, aged twenty-two Engineer on air compressor engine Elbow and forearm caught between the



# JOHN WILLIAM FREEMAN

bumpers of mine engine and car Fracture of humerus at junction of shaft and condyles, contusion and laceration of muscles of the forearm, and cutting off the radial artery followed by large blebs on the forearm, gangrene of all the fingers and death of metacarpal bones Amputation in metacarpal region The pronator radii teres entirely sloughed out Results Good union and motion of elbow Loss of most of the hand, but good stump Time, 118 days

## RADIUS

Case	Time off		
1	25 L/3	Styloid	Good result
2	15 L/3	Styloid	Good result
3	36 L/3	Styloid	Good result
4	13 L/3	Styloid	Good result

## RADIUS AND ULNA

Case	Time off, 4 Yr		
1	50 L/3	Colles	Good result
2	50 L/3	2 in above	Good result
3	57 L/3	Colles	Good result
4	57 L/3	Colles	Good result
5	34 L/3	Colles	Good result

## METACARPAL

7 cases time off, 20 days average

## PHALANGES

39 cases average time off, 18 $\frac{1}{4}$  days

## PELVIS

Case	Age	Time off		
1	21	15	Ilium crest	Results good
2	42	30	Spinous process	Results good
3	30	59	Ilium	Results good
4	28	25	Ramus	Results good
5	23	26	Both rami, lap ruptured bladder	Died
6		28	Coccyx	Results good

CASE V—Was caught between rocks and badly squeezed Fracture of both rami of ilium, rupture of urethra at base of bladder and at the fundus into abdominal cavity Operated, bladder closed, drainage General sepsis Death in twenty-six days

## FEMUR

Case	Age	Time off	u/3	m/3	L/3	Operated	Functional Results	Anatom Results
1	21	96	1				Good	Good
2	30	110		1			Good	Good
3	27	141	1				Good	Good
4	40	225		1		Plated	Good	Good
5	21	113		1			Good	Good
6	33	269		1			Good	Good
7	38	586		1		Plated	Not good	Not good Comp
8	30	465	1	..	.	Nailed	Not good	Not good
9	52	9				Died, old osteomyelitis		
10	26	123			1		Good	Good

# FRACTURES OF BONES IN GOLD MINING

## PATELLA

Case	Age	Time off	Operated	Functional Result	Anatomical Result
I	35	159	Wired	Good	Good

CASE VII—June 16, 1912 J. E. B., aged thirty-eight. In poor health with profuse purulent expectoration B questionable Fracture at junction of middle and lower third August 24, apparently good union and sent home December 11, went to work. December 16, fell off a porch, hurt the leg, but did not rebreak it January 6, 1913, went to work again, and was not seen or examined until May, 1914, when it was discovered he had a very large callus and a false joint. We then operated, chiseling off part of the callus, cutting off the ends of the bone, bone plate applied July 29, plate removed due to infection showing up August 15, allowed to go home with plaster cast on September 29, readmitted with osteomyelitis of the lower third and only partial or springy union Operated, diseased portion cleaned out May 31, allowed to go home with retention splint August 11, 1915, went to work Total loss of time, 586 days Result one and one-fourth inch shortening, partial stiffness at knee, solid union

CASE VIII—November 9, 1912. J. C., aged 30 Fractured neck of femur. Treatment extension and abduction December 31, discharged from the hospital with apparently good union, as shown by examination and X-ray. October, 1913, noticed him walking with a good deal of a limp. X-ray and examination showed no union, with absorption and shortening of neck, with 1½ inch shortening of leg October 20, operated, capsule opened and found to be partly between the break This was removed by a bone curette Shaft nailed to neck with two nails Plaster of Paris from toes to waist February 2, 1914, one of the nails had begun to give trouble and both were removed July 1, 1914, went to work Total loss of time, 465 days. Results Functional, good; anatomical, ¾ inch shortening

## TIBIA AND FIBULA

Case	Age	Time	Tib	Fib	Int Mal	Ext Mal	L/3	m/3	u/3	Op-	Fun Res	Ana Res	Good	Remarks
1	35	154	I	I	.	..	I	..			I	I	I	Comp Com
2	57	192	I	I	.	.	I	.			I	I	I	
3	25	155	I	I	.		I			Nailed	I	not	I	CC spiral
4	28	122	I	I	..	.	I	.	..	.				
5	38	120	I	I		.	I		.		I	I	I	
6	29	77	I	I		.	I				I	I	I	
7	29	43	I	I		.	I							Died, T B
8	31	114	I	I	I		I	.			I	I	I	
9	45	147	I	I	.	.	.	I			I	I	I	
10	31	114	I	I	.	..	I		.	.	I	I	I	
11	25	225	I	I	.		I	.	..	Drilled	I	I	I	C C D union.
12	43	226	I	I	I	.	I	I	.		I	I	I	CC
13	29	122	I	I	..	..	.		.		I	I	I	CC

# JOHN WILLIAM FREEMAN

Case	Age	Time	Tib	Fib	Int Mal	Ext Mal	L/3	m/3	u/3	Opr	Fun Res	Ana Res	Good	Remarks
14	58	89	I	I			I				I	I	CC	
15	22	132	I	I			I				I	I		
16	21	275	I	I			I			Amput				CC, ampt
17	39	51	I	I			I				I	I		
18	19	96	I	I	I	I	I				I	I		Astragalus
19	47	107	I	I			I				I	I		
20	53	90	I	I					I		I	I		
21	32	153	I	I			I				I	I	Comp	
22	37	84	I	I			I				I	I		
23	31	110	I	I	I		I				I	I		
24	40	77	I	I			I				I	I	CC	
25	23	153	I	I			I				I	I	CC	
26	33	196	I	I			I			Plated	I	I	CC	
27	41	120	I	I			I				I	I	Comp	
28	32	58	I	I	I		I				I	I		
29		66	I	I			I				I	I		
30	27	52	I	I	I		I				I	I		
31	38	107	I	I					I		I	I	Comp	
32	21	96	I	I			I				I	I		
33	45	170	I	I						I	I	I	Con int joint	
34	35	139	I	I					I		I	not	Com Back-ward bowing into joint	
35	57	161	I	I						I	I	I	Com into joint	
36	21	101	I	I			I				I	I		
37	23	79	I	I	I		I				I	I		
38	39	78	I	I			I				I	I		
39	44	122	I	I			I				I	I	CC	
40	28	4	I				I				I	I	Died, inj to brain	
41	35	72	I				I				I	I		
42	25	145	I							I	I	I		
43	26	140	I							I	I	I	into knee-joint.	
44	30	53	I		I						I	I		
45	25	148	I				I				I	I	CC	
46		83	I				I				I	I		
47	35	22	I		I						I	I		
48	29	33	I		I						I	I		
49		46	I		I						I	I		
50		60	I		I						I	I		
51	61	212	I							I	I	I	Com into knee-joint	
52	45	19	I		I						I	I		
53	39	90	I				I				I	I		
54	25	77	I				I				I	I		
55	24	59	I				I				I	I		
56		25	I				I				I	I		
57	30	10	I				I				I	I		
58	35	24	I		I						I	I		
59	45	101		I		I					I	I		
60	28	10		I						I	I	I		
61	29	85		I			I				I	I		

# FRACTURES OF BONES IN GOLD MINING

Case	Age	Time	Tib	Fib	Int Mal	Ext Mal	L/3	m/3	u/3	Opr	Fun Res Good	Ana Res	Remarks
62		49		I			I				I	I	
63	34	38		I			I				I	I	
64		38		I			I				I	I	
65	25	83		I		I					I	I	
66		32		I			I				I	I	
67	50	64		I			I				I	I	
68		42		I			I				I	I	
69	25	18		I			I				I	I	
70	30	78		I			I				I	I	
71	33	25		I			I				I	I	
72		21		I			I				I	I	
73	30	30		I				I			I	I	
74	29	30		I				I			I	I	
75		26		I				I			I	I	
76	30	30	I				I				I	I	

## TARSUS

4 cases            average time, 90 days each

## METATARSUS

31 cases           average time, 32 days each

## TOES

70 cases           average time, 14 days each

CASE III—E P, aged twenty-five Compound comminuted spiral fracture of tibia and fibula at junction of m/3 and L/3 Loose fragments removed, bones fastened with two 10-penny nails Functional results good and anatomical results not good, owing to shortening of an inch Number of days off, 155

CASE XI—L, aged twenty-five Compound comminuted fracture of tibia and fibula, delayed union Ends of bones drilled Plaster cast applied and had him walking on it Functional and anatomical results perfect Days off, 225

CASE XXVI—F S, aged thirty-three Compound comminuted fracture two inches above ankle-joint Tibia dislocated backward Impossible to hold in reduction Badly infected, plated fourteen days after injury Functional and anatomical results good Plates removed in March Time off, 196 days

CASE XXXIV—C C, aged thirty-five Compound fracture of tibia and fibula Delayed union Turned loose too soon Backward bowing Functional results good, anatomical results not good Time off, 139 days

CASE XVI—F S, aged twenty-one Compound comminuted fracture of tibia and fibula just above ankle-joint, followed by bad infection Amputation below knee six days later Infection extended up the leg in the knee-joint Result, stiff knee-joint Time off, 275 days

From the foregoing table we glean the following facts. That simple fractures require less time than comminuted, or compound comminuted, in operative cases For example

# JOHN WILLIAM FREEMAN

		Average days off	
Tibia	Simple	61	
Tibia	Comminuted into knee-joint	212	Old man sixty-one years
Tibia	Compound comminuted	148	
Tibia and fibula	Simple	99	
Fibula	Simple	44	
Tibia and fibula	Comminuted	144	
Tibia and fibula	Compound comminuted	169	
Tibia and fibula	Comp comminuted operated	192	

## FRACTURES FROM AN ECONOMIC STANDPOINT

The Company and Hospital have computed the cost of taking care of the injured and find the following results

For every dollar the man loses in wages by not being able to work, the Company spends a like amount to get him well. The underground worker receives on an average \$3 25 a day. When injured his pay stops, but he draws \$1 00 per day from the Aid Fund, without any expense to himself for surgical services or Hospital. For example, a man loses 100 days equal to \$325 00, he draws \$100 00 from the Aid Fund, a loss to him of \$225 00 and a cost to the Company of \$325 00 besides the loss of efficiency in breaking in a new man. Totaling the 311 cases we have the following losses to the employes and also to the Company

Fractured bones	No of cases	No days off	Loss in wages	Received from aid fund	Net loss to employe	Cost to company
Skull	25	976	\$3172	\$976	\$2196	\$3172
Hyoid	1	9	29 25	9	20 25	29 25
Vertebrae	1	7	22 75	7	15 75	22 75
Clavicle	4	182	591 50	182	409 50	591 50
Scapula	1	23	74 75	23	51 75	74 75
Ribs	25	825	2681 25	825	1856 25	2681 25
Humerus	1	117	270 25	117	153 25	270 25
Radius	4	89	289 25	89	200 25	289 25
Radius and ulna	5	248	906	248	658	906
Metacarpal	7	140	453	140	313	453
Phalanges	39	721	234 25	721	1622 25	2343 25
Pelvis	6	183	594 75	183	411 75	594 75
Femur	10	2137	6945 25	2137	4808 25	6945 25
Patella	1	35	113 75	35	78 75	113 75
Tibia and fibula	39	4773	15512 25	4773	10739 25	15512 25
Tibia	19	1322	4296 50	1322	2974 45	4296 50
Fibula	18	800	2600	800	1800	2600
Tarsus	4	360	1170	360	810	1170
Metatarsus	31	992	3224	992	2232	3224
Toes	70	980	3185	980	2205	3185
Totals	311	14919	46365 75	14919	31446 75	46365 75

# ON THE NATURE OF NEUROPATHIC AFFECTIONS OF THE JOINTS \*

BY LEO ELOESSER, M.D

OF SAN FRANCISCO

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WE are no further in our knowledge of the joint lesions accompanying nervous disease than we were twenty-five years ago. The best expositions of the subject date back to this time, more recent ones have added nothing new and have often left out of consideration facts of importance. Theories and speculation as to the etiology of nervous arthropathies began directly they were described by Charcot in 1868, and continue to this day. The whole discussion turns about the question, "Is the primary cause of these arthropathies to be sought in the nerve-lesion, is the nerve-lesion the primary exciting factor, or is it merely incidental and aggravating?"

Do the nerves exert some mysterious "trophic" influence on the bone, or will an alteration of the normal warning sense of pain suffice to explain the occurrence of osseous affections? Are we to seek the primary lesion in the bones, and to regard the nerve changes as merely incidental, and in certain cases as aggravating, perhaps? Are Charcot joints nothing but ordinary syphilitic deforming arthritides, and the spontaneous fractures of tabes nothing but ordinary breaks made painless by tabic analgesia, or do these bone changes, arthritides and fractures, merely serve as moments (*auslosende Momente*) inciting processes whose whole course and termination are determined by the accompanying nervous factors, trophic, analgesic, or what not? The problem is involved, it has too many uncertain quantities to admit of clinical solution. On the side of the nerves we have had the question "*Are there any trophic nerves?*"—and we did not know. On the side of the bones we had the question "What is a deforming arthritis, what causes it?"—and until recently we did not know. Twenty years ago Klemm, of Riga, recognized the difficulties of a clinical solution and proposed experimental work on the subject, but the time was not ripe. Barth asked how we could hope to explain a neuropathic deforming arthritis, when we did not even know the nature of an ordinary one. Now the last few years have brought us nearer to a solution, we at

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\*This paper was on the Program of the Orthopædic Section of the 1915 A M A Meeting, a sudden departure for abroad prevented its presentation. Continued absence has made it impossible for me to consider literature later than May, 1915. The first part of the work was done in the Division of Surgery, University of California. The paper was read before the Stanford Clinical Society, October 9, 1916.

least have some knowledge as to the nature of an ordinary deforming arthritis, and have been able to produce it experimentally, and have thus eliminated one of the uncertain quantities. So that I set myself the problem of determining the cause of Charcot joints and went at it from various directions.

Let me first state the questions involved.

1 Are tabic arthropathies due purely to degeneration of certain nerves that cause the bone to atrophy? (Charcot's theory)

2 Are they simple syphilitic arthritides, occurring sometimes in the course of a tabes, but not infrequently found in the absence of any nerve lesion? (Barré and Babinski)

3 Are they due to the combined influence of nerve and bone lesions? If so, where does the primary change lie?—In the nerve or in the bone? What is the nature of the nerve-change? Is it merely a lack of sensibility, or is it the degeneration of some nerve assumed to exert a trophic influence? What is the nature of the bone-lesion? Is it an arteriosclerotic deforming arthritis, or a syphilitic one, or one the result of an unfelt trauma?

In order to answer these questions I aimed to produce lesions in cats simulating as nearly as might be tabes in man. I cut a series of posterior roots leading to a particular extremity, enough of them to make a total analgesia, anæsthesia and ataxy. This eliminated many of the factors complicating tabes, the underlying syphilis, for instance. Sections of cords from these cats show an ascending degeneration of the posterior columns corresponding to what would be in man a one-sided tabes (Figs 1 and 2). Cutting one side only enabled me to have the other as a control. I watched the cats for a considerable period and had the satisfaction of seeing some of them under certain conditions develop what in man would be called a Charcot joint or a tabic fracture.

I then produced joint changes in another series of animals, and after waiting some time, cut the posterior roots, so as to see what effect the nerve-lesion might have on the process in the joint. Then I reversed the order of experiment, cut the roots first, let the cat accustom herself to the anæsthetic limb, and after a month or so induced a deforming arthritis, to see whether this lesion in an enervated joint would immediately assume the extravagant course of a tabic arthropathy. And finally, to refute those who might object that depriving a limb of its sensibility might cause its disuse, and that a possible atrophy might be due merely to inactivity, and not to a trophic nerve influence, I cut three dorsal roots, leading to as many ribs, in a further series of cats. As the ribs were moved along with the movements of their neighbors, there could be no assumption that any trophic change that might be found would be the result of muscular inactivity. All cats were operated on under full ether anæsthesia.

I am indebted to a number of friends for help in this work,—to the

late Dr Painter, Drs Howe and Markel for X-rays, to Prof O'Neill, of Berkeley, for chemical analyses of bones, to Prof. Wing, of Stanford, for tests of tensile strength, to Mr L Heynemann, M E, of San Francisco, for suggesting and giving me an apparatus for the determination of deflection under cross-strain, to Dr Blaisdell for micro-photographs, and finally to the aid of my attendant, Mr. Moran

Sixty-nine cats were used for the experiments, and 42 of them were observed for greater lengths of time, from 3 months to over three years. The rest died of intercurrent diseases, sepsis in the anæsthetic limbs, or other complications. After cutting a sufficient number of roots the affected limbs showed the clinical picture of advanced tabes. They were atactic and their muscle-sense was gone. The gait was unsteady, the cats would frequently paw the air a few times before setting the limb to the ground, as though to make sure of its position. Often, in the attempt to make a step, instead of bringing the leg forward the cat would extend it stiffly in all joints, and would drag the limb rigidly after it for a few paces before moving it again. The awkwardness and spasm were atactic, not paralytic. Many of the cats got deep ulcers on the dorsum of the foot from dragging it along the ground. Muscular hypotony was marked, many of the cats walked with an outward rotation of the hip which may have been the cause of the dislocations of the hip-joint noted in some of the animals. Ataxy and atony were less strong in the unilateral resections than in the double ones. For days and sometimes weeks, the cats with bilaterally resected roots would make but few attempts to use their hind-legs. They would hold them extended backward stiffly, and would slide along the floor with their groins and knees touching the ground, as though they did not know that they had hind-legs. They were not paralyzed, however, since they would kick vigorously if lifted by the nape of the neck. The unilateral resections rarely caused bladder disturbances, the bilateral ones were often followed by fecal incontinence, and sometimes by a fatal cystitis. In all successful resections there was complete loss of the sense of pain, both in the soft parts, the skin, and the bone. The periosteum of the affected leg could be pricked with a pin without the cat's evidencing discomfort. The knee-jerk on the affected side was lost. A cross reflex might be obtained by tapping the sound patellar tendon, when both knees jerked, but on tapping the affected tendon no knee-jerk appeared on either side.

Now as to the results of the resections. Nineteen cats with unilateral resections of posterior roots were observed for periods of from three months to three and a quarter years. Of these, two got a fracture of the head of the femur, one a fracture of the great trochanter, three a coxa vara, three had dislocations of the hip, one a fracture of the tibia, one a fracture of the fibular malleolus, one a Pott's fracture, and six showed various lesions about the ankle-joint, fractures of the bones of the foot, etc, some of these animals had multiple bone and



joint lesions, in six of them no abnormalities of the bones or joints could be found.

Three cats with a bilateral rhizotomy were followed for over six months. Of these one showed an arthritis of both hips with coxa vara, one merely a metatarsal fracture, while the third got a fracture of the head of the femur on one side and on the other a fracture of the middle of the femur, a typical Charcot knee with luxation of the tibia, and a Charcot ankle with fracture of the os calcis.

Sixteen further cats that died of intercurrent disorders could be observed but for a shorter period of from four to ten weeks. Of these two had pus joints, both of them a hip that was dislocated and full of pus, one of them a purulent Charcot knee besides, one of them had a fracture of the neck of the femur, two fractures of the tibia and fibula, five others had tarsal fractures or joint lesions, in five the bones and joints seemed intact, but even of these, two were noted as having but little anæsthesia of the side whose roots had been resected. So, out of thirty-eight cats with disturbances of sensibility of the legs, twenty-seven developed spontaneous lesions of the bones or joints.

It is difficult to know how much stress to lay on changes at the ankle. Disintegration of the metatarsal or tarsal joints and fractures of the bones about them were common, and occurred in fourteen cases out of the thirty-eight, sepsis from an open ankle-joint was a frequent cause of death. Almost all the cats had ulcers of the anæsthetic foot, and it may be that changes at the ankle-joint were effects of the supuration near by, however, lesions of the hip, femur, knee and tibia being uncomplicated by suppuration, were characteristically neuro-pathic. It is noteworthy that all the eight joints showing the peri-articular ossifications and destructive arthritis typical of Charcot's arthropathies were seats of a fracture that ran into or near the joint.

The mere production, therefore, of these bone and joint changes in healthy animals has disproven some of the theories as to the cause of tabic arthropathies, viz. the theory of a luetic origin, and that of a primary deforming arthritis.

To see whether there was any change in the composition of the bones following root-resection I had bones from the affected and from the sound side analyzed chemically. They showed no chemical difference. Prof. Wing, of Stanford, was so good as to have tensile strength tests made for me, these, however, presented such technical difficulties and were so full of sources of error that we gave them up, and at the suggestion of Mr. L. Heynemann, M.E., tried measuring the deflection of the bones under a given load, as being easier and giving a more useful criterion of their strength and elasticity. Mr. Heynemann had built for me the little apparatus shown in Figure 14. The ends of the bone are supported by two narrow pieces of metal, over the middle of the bone is placed a hook from which a weight may be

hung The deflection of the bone under the load of a given weight is measured by the vernier riding overhead on a slotted bridge Tests both of the ribs whose nerves had been resected as mentioned before, and of the bones of the leg, showed certainly that the bones from the *affected side were not weaker than the controls from the sound side* In fact, both these strength tests and the X-ray seem to show that the bone on the enervated side is usually a little stronger than on the sound one We may assert then, as a result of forty determinations on some thirty-two ribs and fifty-three determinations on various other bones, that there is no osseous *atrophy* produced by a disturbance in conduction along the posterior roots These determinations make untenable Charcot's theory that a trophic disturbance causing a *wasting* of the bone is at the root of these arthropathies

Whether there may not be some nerve influence, a "trophic" influence (whatever that may be), that causes a change in the metabolism of the bone, causes it to become more dense, more sclerotic, more liable to arthritis, and more rigid, more liable to fracture, I should not like to say. Especially the case of cat No 32, where one rib of the three anæsthetic ones was found broken at autopsy, might make one suspect some such factor There are, however, so many agencies at work in a tabic limb that might produce fractures,—the sudden pull of atactic muscles, the lacking muscle sense which brings the limb into unnatural positions little adapted to resist strain, the anæsthesia and analgesia,—that I do not see why it is necessary to have recourse to the assumption of a mysterious and unproven "trophic" influence in order to explain tabic fractures The denseness of the tabic bones seen in the X-ray plates might also well be merely a response to added demands, to increased sudden stresses and strains arising from the ataxy, lacking muscle-sense and analgesia previously mentioned

Some of the cats showed coxa vara, a number of them an obviously traumatic one, but some hips were without the least evidence of fracture or other injury,—it was, however, noted that just these cats walked with rigidly outstretched legs or with an uncertain and wobbling gait, treading now on the sole, now on the dorsum of the deflected foot, so that their varus deformity may as well have been a static one as due to some particular nervous "trophic" cause In short, there is nothing in our findings that proves the existence of changes in the texture of the bones that may not be accounted for by conditions arising solely from an altered function dependent on a lack of sensibility, nothing in these findings that gives proof of the existence of "trophic" nerves

We have then to look for the cause of these joint affections in influences due to some combination of both the nervous and the bony lesions Can we find it in an ordinary deforming arthritis aggravated by a lack of a warning sense of pain? To answer this question I induced a deform-

ing arthritis with the thermocautery after the method of Axhausen, in both knees of thirteen cats, waited for the wounds to heal soundly and the inflammatory reaction to disappear and followed the operation on the knees by a unilateral root-resection. Six of these animals were observed for over four months. In five of them no characteristic difference could be seen in the degree of arthritis on the analgesic and the sound side, one of them (Figs 6 and 7) developed a typical Charcot knee in the joint which was at the same time arthritic and analgesic. In this cat it was noted from the beginning that the leg was carried awkwardly, with the knee doubled under. This proportion of one cat in six proves nothing, as an equal proportion of cats in the series where the joints were not made arthritic artificially developed spontaneous joint-lesions.

The presence, therefore, of a moderately severe arthritis is not sufficient to make an analgesic joint develop a characteristic arthropathy. Furthermore, we cannot explain the cause of an arthropathy by the assumption of an atrophying influence of degenerated nerves. And finally, we cannot see in these lesions simply an aggravated form of a luetic arthritis. Where have we then to look?

As a companion-piece to the last-named order of experiment I resected the posterior roots in three further cats, and after waiting a number of weeks, opened the joints and seared a spot on the femoral condyles with a thermocautery. *Within three weeks every one of these three cats developed a Charcot joint* with a huge joint hydrops, deformity and grating of the joint surfaces (see Figs 16 and 17). This, then, was not a slow aggravation of a pre-existing deforming arthritis, it was the sudden response of an anæsthetic joint to the acute trauma of operation, a rapid reaction to bone injury by the production of a typical Charcot joint.

Moreover, it was not only in this last series of experiments, where the limb was purposely subjected to trauma, but in all the experiments as a whole that we find that the cats that were the ones to develop arthropathies, spontaneous luxations of the hip, Charcot knees, or spontaneous fractures were those that did not suffer from operation, those that were lively and active, and we find particularly noted that it was those that held their limbs in awkward and unnatural positions that developed bone and joint lesions. Hence it was the animal most subject to trauma that most often suffered bone or joint trouble. The joint lesions themselves were visibly of traumatic origin, eight of them still showed fractures near the joint, others dislocations such as the joints shown in Figs 3, 4, 5, 8, 9, 10, 11, 12, 13 and 17. This agrees with clinicopathological observations in man, with the fact that arthropathy is a lesion of *early* tabes, a lesion occurring during the time when the tabetic is still subjecting himself to trauma, and is much rarer in the late atactic or paralytic stage when the patient is weak and confined to

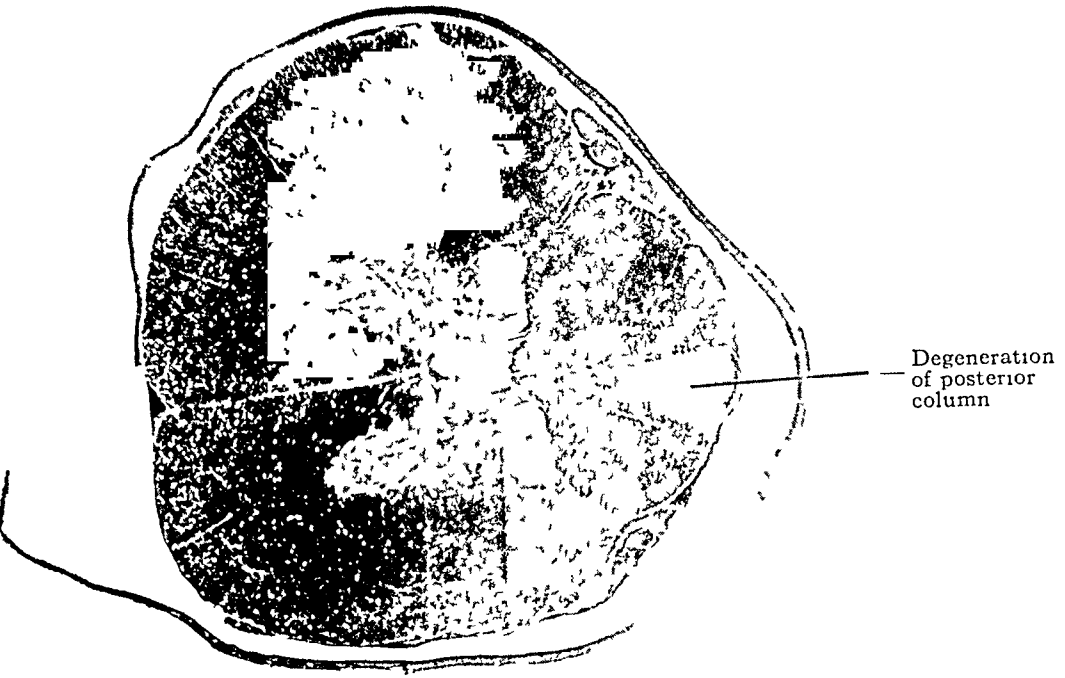


Fig 1 —Spinal cord of cat No 33 Weigert stain Microphoto-  
graph by Dr Blaisdell

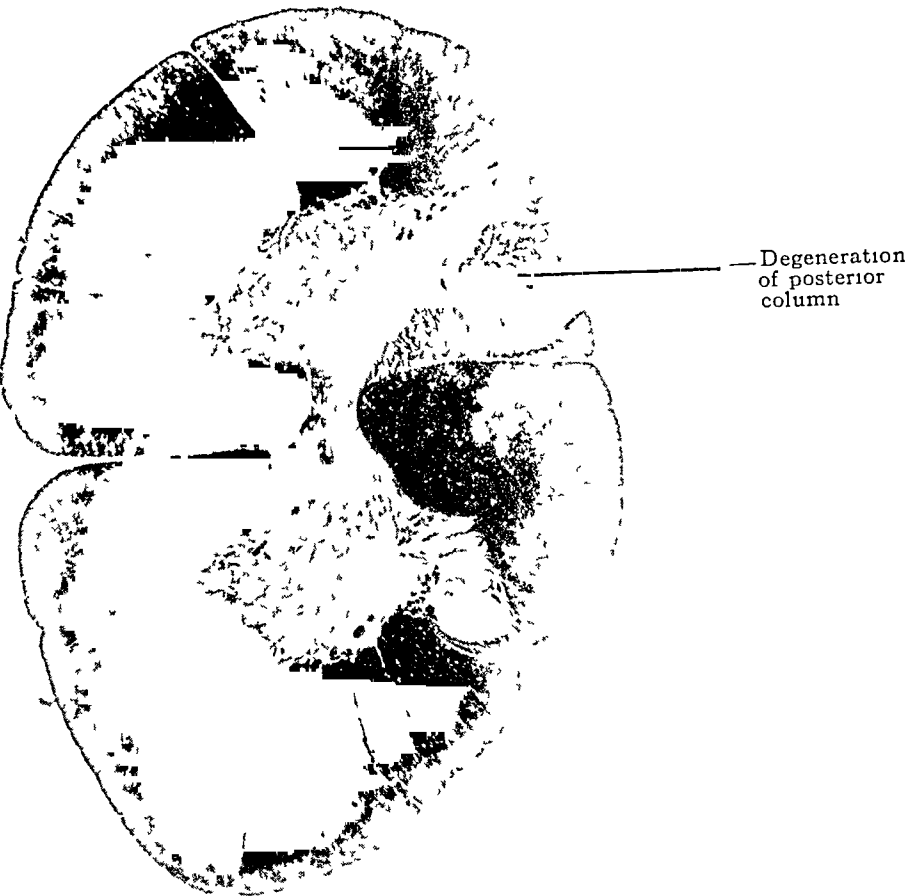


Fig 2 —Spinal cord of cat No 48, Weigert stain Microphotograph by Dr Blaisdell



FIG 3 —Cat No 52 Charcot knee with dislocation



FIG 4 —Cat No 52 (same as Fig 3)



A



B

FIG 5 —X ray of cat No 1 Fracture of the neck of the femur The bone on the affected side B is denser than on the sound side A, as was the case in many of the cats with bone and joint lesions

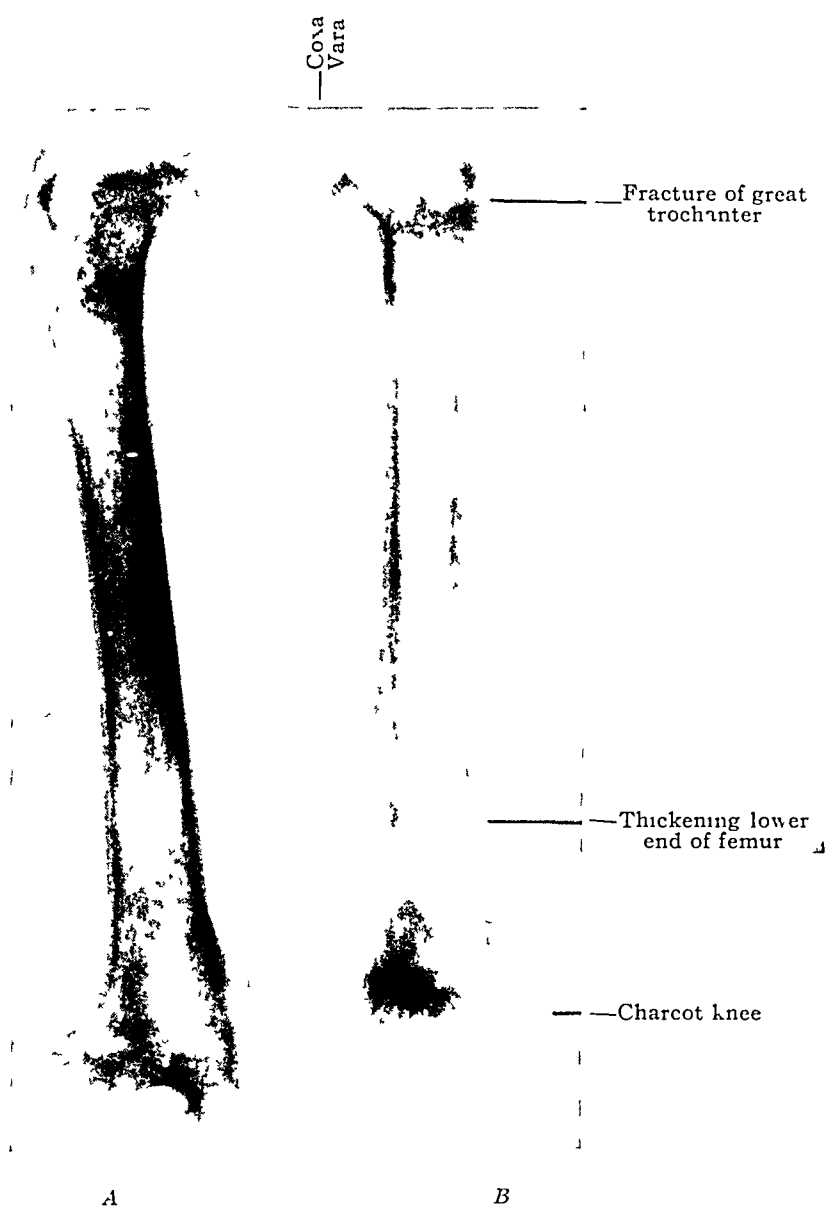


FIG 6 —X-ray of femurs cat No 61. The affected side *B* shows coxa vara, fracture of the great trochanter much thickening of the lower end of the femur and a Charcot knee with marked deformity of the condyles. See photograph of knees Fig 7

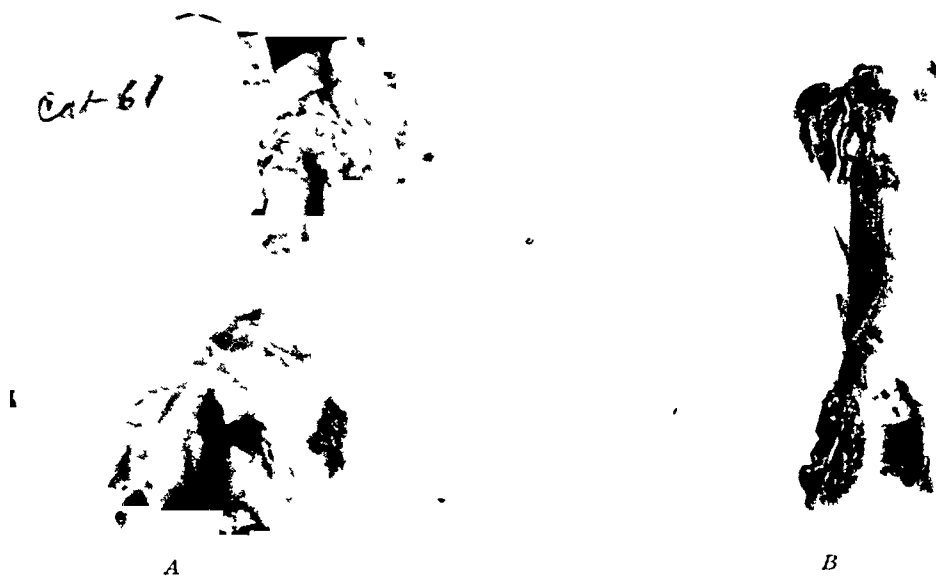


FIG 7 —Cat No 61. *A* right femur. Condyles show hypertrophic ossifications and extragant changes in form incident to Charcot knee. *B* left femur. Condyles (upper anterior part) show erosions of deforming arthritis after thermocauterization



FIG 8 —X ray of pelvis with dislocation of hip-joint Cat No 42



FIG 9 —X-ray of ankle cat No 25 showing disintegration of the ankle-joint ( Pied tabétique )

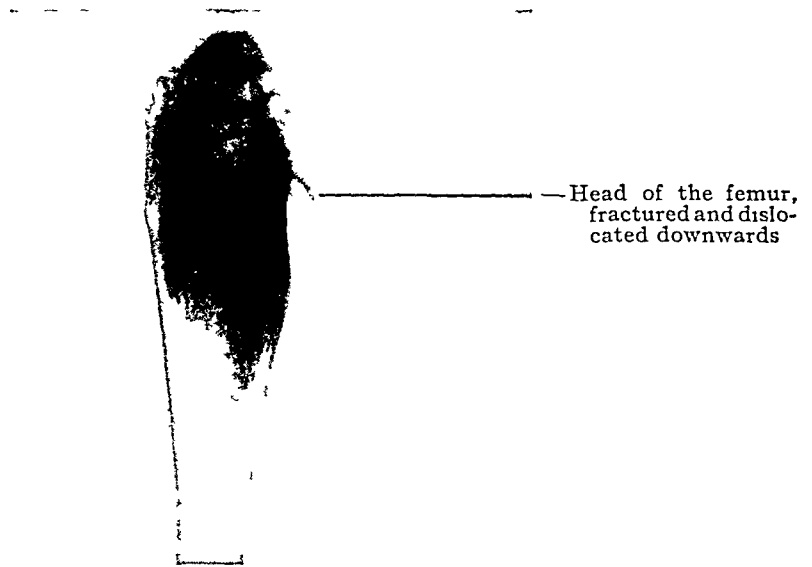


FIG 10 —X-ray of Charcot hip with fracture of the head of the femur and much thickening of the bone Cat No 13

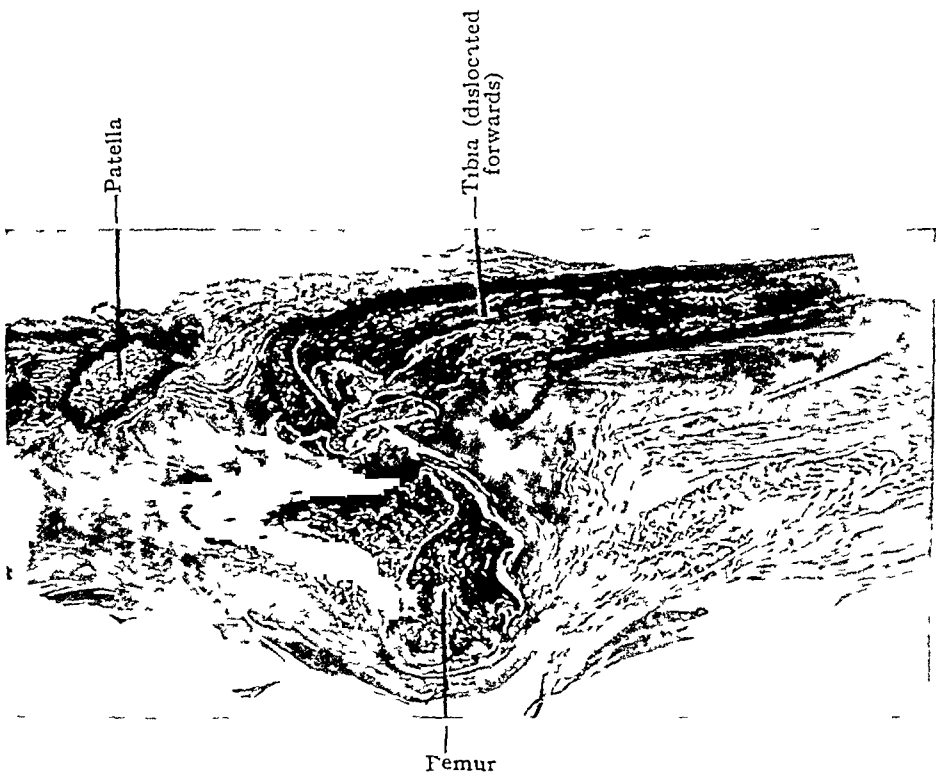


FIG 11 —Microtome section through Charcot knee with dislocation of the tibia Cat No 13



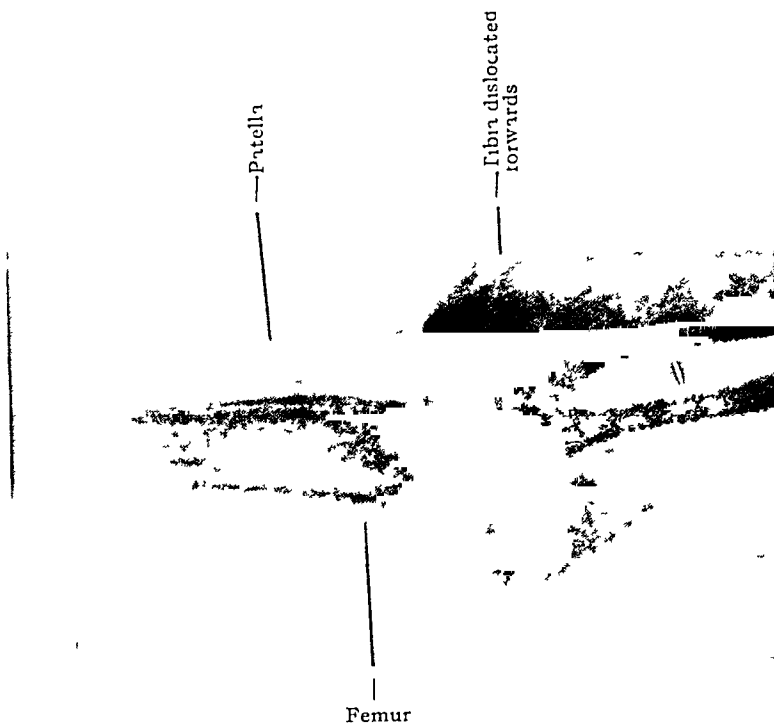


FIG 12 —X ray of same joint as Fig 11



FIG 13 —X ray of pelvis with dislocation of hip joint Cat No 51

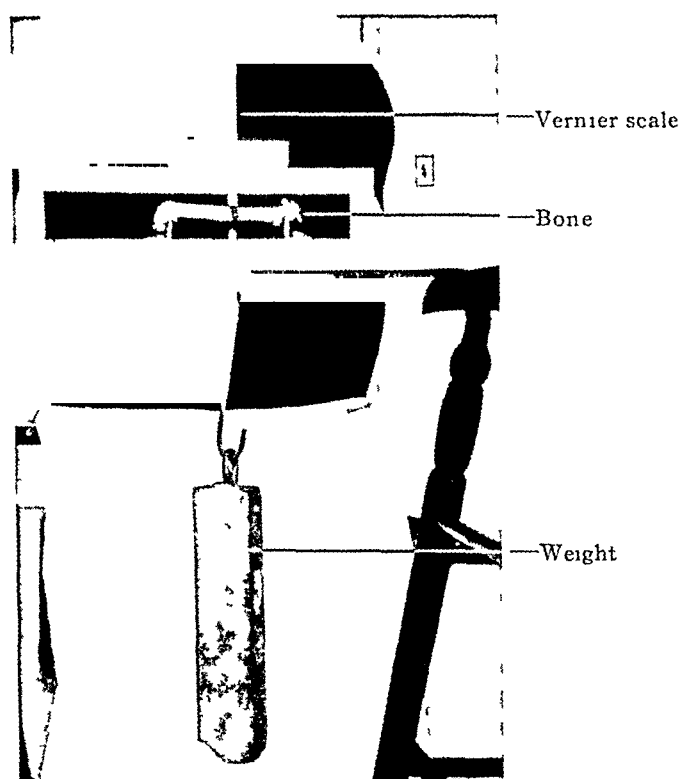


FIG 14 —Apparatus for measuring deflection of bone under a given load

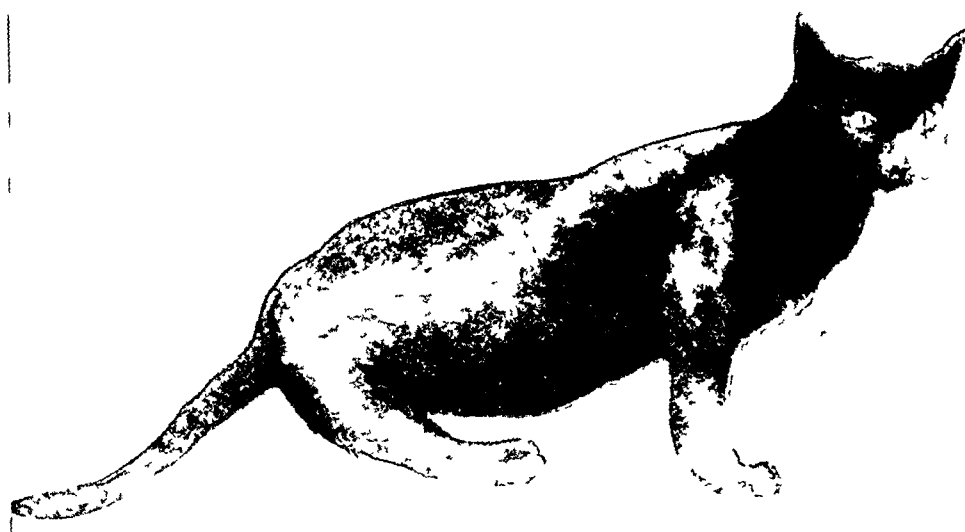
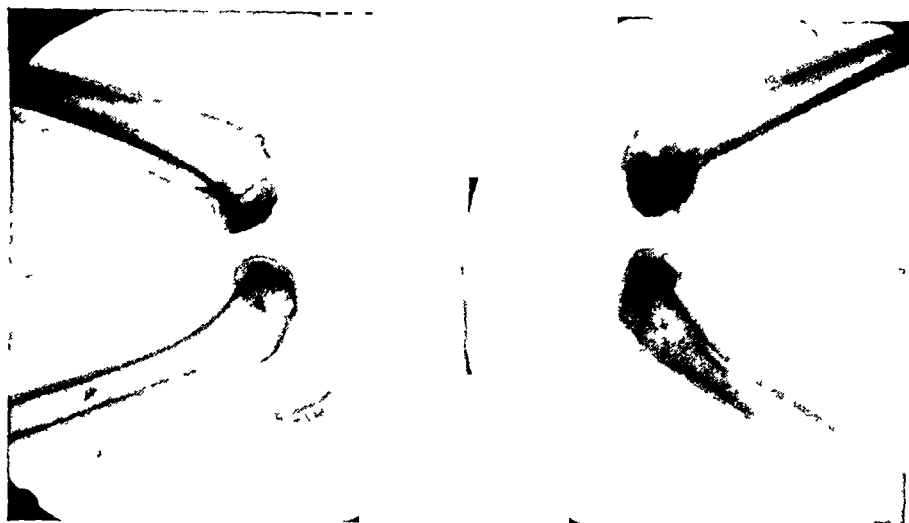


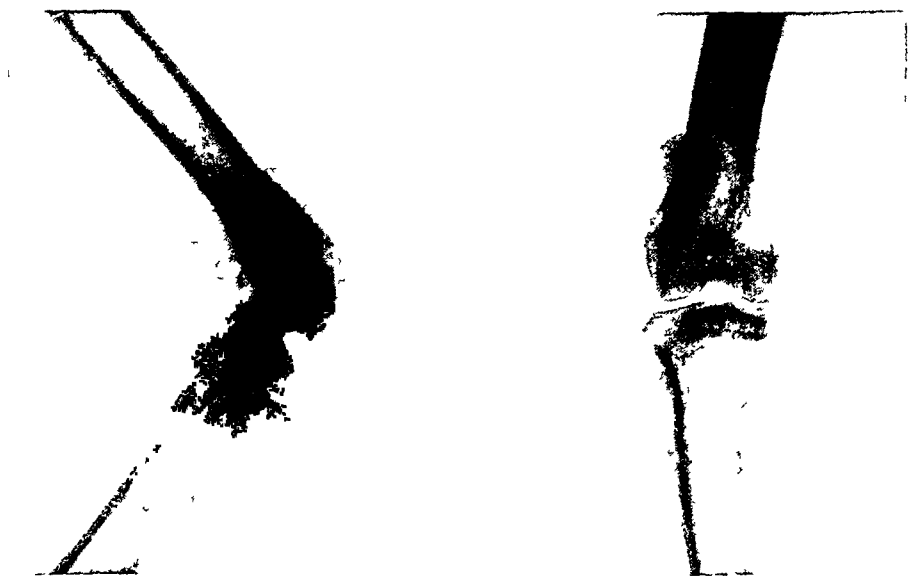
FIG 15 —Cat No 48, Charcot knee and eversion of hip-joint (see Fig 16)



*A*

*B*

FIG 16 —X-ray of Charcot knee cat No 48 *A* sound side, *B* affected side



*A*

*B*

FIG 17 —X rays of Charcot knee in cat No 33 *A* affected side *B* sound side



FIG 18 —X-ray of Charcot joint following old gunshot wound of the knee The blotchy shadows around the joint are caused by lead from the bullet deposited in the tissues of the joint-capsule



FIG 19 —X-ray of Charcot joint following subtrochanteric fracture of the femur



bed It agrees with the findings in man, where in many Charcot joints we see evidence of old trauma, such as in the case shown in Fig 18, where a Charcot followed an old gunshot injury, or in the case of a Chinaman in the University of California Service at the San Francisco Hospital, where it followed an evident fracture of the head of the tibia, or in the case of Fig 19, where it followed a subtrochanteric fracture of the femur The assumption of a trauma also explains the great para-articular ossifications and proliferating periostitides characteristic of these joints, comparable to the hypertrophic callus that MacEwen found in his fallow deer All of these are findings inexplicable under the assumption of an atrophying nerve influence, which to explain them all simultaneously would have to be at once atrophying and hypertrophying The trauma may be slight, but lacking the protecting sense of pain, a simple lesion may turn into a graver one from the added insult of unwholesome use

I think, therefore, that in the assumption of trauma, grave or slight, plus lack of the protecting sense of pain, we have sufficient explanation for the origin of most Charcot joints

#### CONCLUSIONS

1 Bone and joint lesions corresponding to those found in tabes dorsalis may be induced experimentally in the limbs of cats by severing the posterior nerve roots (the sensory fibres) leading from the limb

2. Severing the posterior roots causes no atrophy of the bone

3 Tabic fractures and arthropathies have been produced in healthy animals, hence they cannot be ascribed primarily to lues or other infectious causes

4 The course of a deforming arthritis is not characteristically altered by the addition of an analgesic factor, hence the cause of the Charcot joint is not to be sought in a simple deforming arthritis occurring in a tabetic

5 Nothing in these experiments gives proof of the existence of trophic nerves

6 Of three animals whose joints were subjected to operative trauma after having been previously rendered anæsthetic by resection of posterior roots, all rapidly developed Charcot lesions Trauma in a limb rendered anæsthetic and analgesic experimentally leads to grotesque lesions of the bone and joints, which are in every way the counterparts of tabic fractures and arthropathies, *trauma and lack of the warning sense of pain are the cause of most tabic bone and joint lesions*

# AN ANATOMIC SUBSTITUTE FOR THE FEMALE BREAST

BY WILLARD BARTLETT, M D

OF ST LOUIS, MO

THE breast is of such psychic importance to the female patient that it is usually late in the course of breast tumors that the surgeon is consulted. It is the fear of having the breast mutilated that keeps patients away and allows a tumor to run a progressive course.

The physiologic function of the breast, naturally, does not interest the patient. As a general rule, it need not interest the surgeon, on account of the age of these individuals, and thus need not be considered at all.

Therefore our problem is to reestablish breast *form*, thus satisfying the psychic element, and not to reconstruct a breast of secretory value which must contain glandular tissue.

Bloodgood has recently shown us that a great number of breast tumors are benign and require only the removal of the tumor or breast itself, instead of the radical, complete dissection, which has often been done in the past, under the mistaken gross and microscopic diagnosis of cancer. Without going too far into histologic detail, one must admit that it is impossible in many instances to separate from a diffuse process, breast tumors which in a certain sense are localizable. This is particularly true in cases of fibrocystic mastitis. One can go even farther and state that every operator has been confronted with patients in whom the diagnosis has been so uncertain that it was difficult for him to decide which of the three operations was really indicated, namely, (1) local removal of the tumor, (2) amputation of the breast, or (3) radical complete removal.

The surgeon does not wish to risk general dissemination of a malignant tumor by inadequate local removal, nor does he wish to needlessly mutilate the patient by a complete removal of the breast for a diffuse lesion which could have been equally well removed by a simple glandular extirpation.

It is just these patients who require simple breast amputation for whom I have done the operation proposed herein, thereby avoiding mutilation and at the same time guarding against the dangers incident to local removal, and, on the other hand, allowing a complete detailed study of the gland tissue removed, so that a complete radical operation can be done at a later date without increasing the risk of dissemination. This operation will most frequently be indicated in cases of chronic fibrocystic mastitis, which is generally admitted to be a pre-cancerous condition, hence, an examination of the whole gland must be made before it is possible to state that no part of it is cancerous. This consideration has led me *to shell out the entire gland-bearing area with the cautery*. Cosmetic considerations have led me to fill out the defect with fat taken from other portions of the patient's body.



FIG 1 —Marking the line of incision

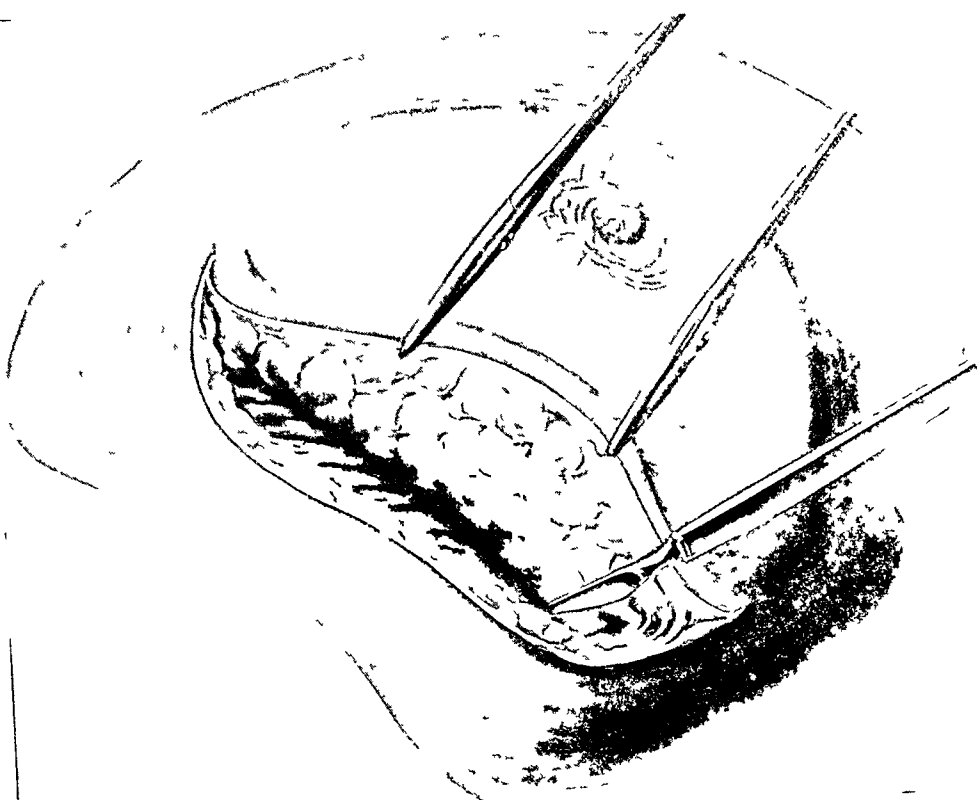


FIG 2 —The primary incision



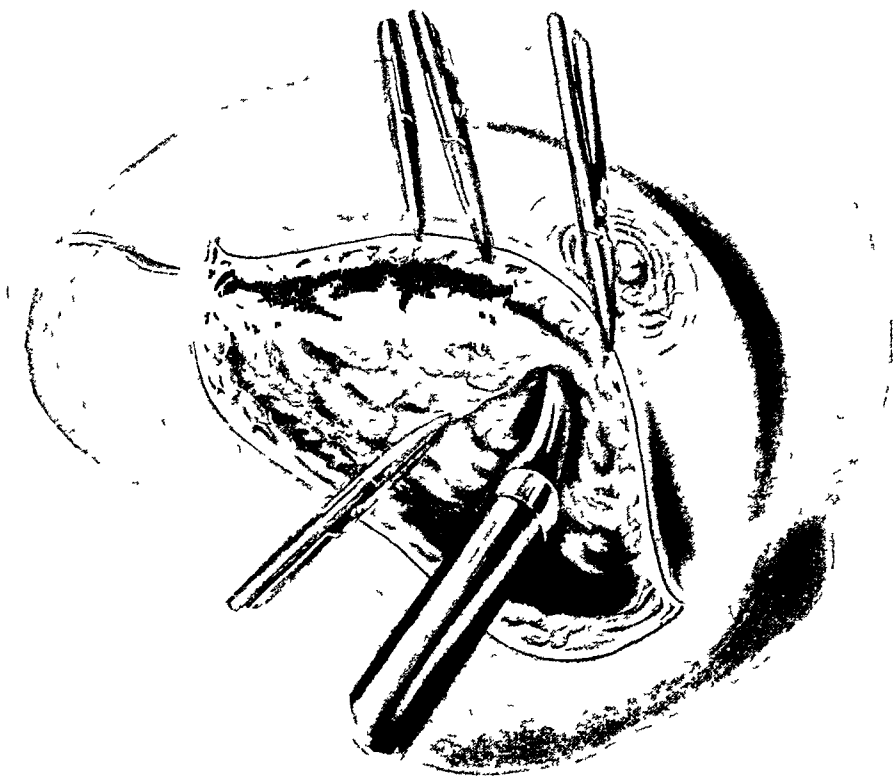


FIG 3 —The skin covering dissected off the gland

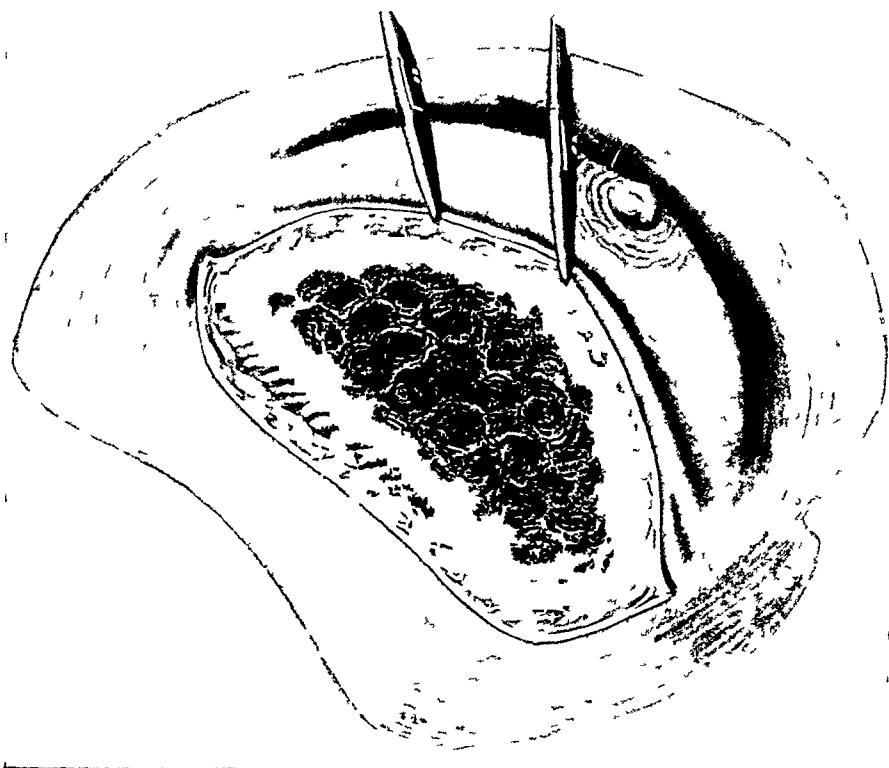


FIG 4 —The fat transplant in its new position

## SUBSTITUTE FOR THE FEMALE BREAST

The various steps of the operation are given in detail, viz . (1) With patient in the sitting posture, the affected breast is lifted and a mark made (Fig 1) in the fold which will be completely hidden by the pendent organ when it is allowed to assume its normal position (2) Patient is covered with two sterile sheets, attached to the skin in such a manner as to expose two areas, one revealing the affected breast, the other, the lower abdomen or thigh on the same side (3) A crescentic incision (Fig 2) is made first below the breast following the line marked out in step (1) The breast is lifted off the chest wall, all attachments being divided with the cautery and the pocket filled with a pack (4) The skin covering the gland is peeled back with the cautery, (Fig 3) while downward traction is exerted on the mass to be removed The natural line of cleavage is found to be close to the skin, but, by using an extremely hot cautery, maintaining only brief periods of contact and always burning toward the gland instead of away from it, it is possible to preserve the skin capsule intact (5) Hæmostasis is, as a rule, not difficult after using the cautery, but must be made absolutely perfect before the next step can be undertaken (6) From the anterior abdominal wall, the outer aspect of the thigh, or the buttocks, enough subcutaneous fat is removed to constitute a mass approximately 50 per cent larger than that which has been extirpated, thus allowing for shrinkage which always takes place This is to be stuffed into the breast defect and allowed to conform to its new surroundings (Fig 4) Pads of gauze are meanwhile creating hæmostasis in the defect from which the fat transplant has been removed (7) The breast wound is then sewn up in two layers, a deep one of catgut reuniting the superficial fascia, and a second one of horsehair, closing the skin Under no circumstances should any provision for drainage be made. It will not be necessary if hæmostasis has been adequate and it is always dangerous, as it may lead to infection of the depths (8) The operation is then completed by closure of the skin wound through which the transplant has been removed It has been my custom to drain these cavities for a few days

There follows a brief résumé of four of the six patients upon whom this operation has been performed

CASE I—(No 6236) Mrs S, age thirty. *Present*—Complains of pain in left breast—one year's duration, subsided at menstruation—completely ceased three weeks ago, when patient noticed a fullness in lower left breast—slightly tender—no redness or local heat—no discharge from nipple

*Past*—Married nine years, mother of two children—nursed both. Seven years ago patient had fissures in this breast which were followed by a mastitis—treated with heat—the tumor has been noticed only one year.

*Objective Symptoms*—A single, hard, irregular and tender tumor, size of a lemon, felt low in left breast—movable

*Provisional Diagnosis*—Chronic fibrocystic mastitis. December 5, 1916. The operation described was done, mass size of man's fist removed, and the defect supplied from the outer aspect of left thigh

*Microscopic Diagnosis*—Substantiates the clinical diagnosis There was slight drainage of fat and serum for a few days, then wound healed normally

June 22, 1917, more than six months after operation, the condition is more than satisfactory to patient The substitute breast is about the size of its mate but not quite so pendulous and of firmer consistence The two nipples look exactly alike

CASE II—(No 6325 ) Mrs C, age thirty-eight *Present*—Complains of a "lump" in median portion of left breast for past two years There has been no noticeable growth of tumor—no pain or any inconvenience

*Past History*—Married fifteen years, two children, nursed both, had a mastitis twelve years ago, treated by massage

*Objective Symptoms*—Multiple tumors size of hazel nut in median portion of left breast, hard, slightly tender

*Provisional Diagnosis*—Chronic fibrocystic mastitis On February 15, 1917, we did exactly the operation described, and in this case also, filled out the defect with fat from the outer surface of left thigh

*Microscopic Diagnosis*—Substantiates the clinical diagnosis There was very much drainage of liquid fat and serum in this case and five weeks after operation a phlegmon developed and discharged spontaneously at the lower periphery of the new breast It was almost three months after operation before the last of several shreds of necrotic tissue were discharged, after which healing was very prompt and the breast was shrunk to about the size of its mate When last seen, four months after operation, the patient expressed herself as delighted with the outcome

CASE III—(No 6421 ) Mrs L, age twenty-nine *Present*—Complains of a small tumor in left breast of two years' duration, fairly rapid increase in size, no pain at present

*Past History*—Mother of two children, nursed both, tumor appeared during lactation of last child

*Objective Symptoms*—A tumor size of a small orange is felt in left upper breast It is irregular, hard and movable

*Provisional Diagnosis*—Fibro-adenoma of left breast On April 22, 1917, this operation was done The defect was filled with fat from the anterior abdominal wall, low in the midline

*Microscopic Diagnosis*—Substantiates the clinical diagnosis About three weeks after operation, a slight drainage of liquid fat and serum appeared at lower angle of wound It drained for about one week, the wound then healed very readily The patient's present condition is well expressed in her communication within one month after operation, "We are very much pleased with your work and grateful for the great consideration shown us"

CASE IV—(No 6459 ) Mrs R, age fifty-three *Present*—Complains of a sudden pain in left breast Three days ago breast became hot and seemed larger than the right and was hard After two days the swelling subsided and patient became fairly comfortable under complete rest in bed Has no pain now except on palpation

*Past History*—Married thirty years, mother of five children, nursed all five, has had no breast trouble with exception of trauma from corset

*Objective Symptoms*—A tumor size of a small orange in middle of left breast, irregular in shape, firm, movable and tender, enormous development of superficial veins radiating towards nipple

*Provisional Diagnosis*—An acute exacerbation of a chronic fibro-cystic mastitis On May 25, 1917, the foregoing operation was done with the cautery, the defect filled with fat from the abdominal wall

*Microscopic Diagnosis*—Chronic fibro-cystic mastitis with numerous retention cysts and a local epithelial proliferation.

This patient made a slow recovery, leaving the hospital three and a half weeks after operation, with sloughing of about one-tenth of the fat transplant

Two of the six patients are still in the hospital, hence a report on them would have no value

It will be seen from the foregoing that success has marked our efforts, as far as concerns the integrity of the transplant, and this in spite of the fact that infection took place in two of the cases It can at least be claimed that the patient who looks down at her breast directly or indirectly in the mirror can see no scar at all. No matter what the ultimate shrinkage, she will have accustomed herself to a very gradual change instead of having to experience the shock of a sudden mutilation

My gratitude is due Dr Harry T Upshaw for his kindness in following up the patients whose histories are given above.

# TRANSACTIONS OF THE NEW YORK SURGICAL SOCIETY

*Stated Meeting, held February 28, 1917*

The President, DR CHARLES N DOWD, in the Chair

## ANEURISM TREATED WITH THE ANTISPECIFIC REMEDIES ALONE

DR WILLIAM C LUSK said that in reporting the two cases of wired thoracic aneurism which he showed before this Society on May 10, 1916 (ANNALS OF SURGERY, lxiv, 1916, p 680), he had dwelt upon the importance of giving antispecific treatment to these cases as a measure which, if the disease were not too advanced, could bring relief to their symptoms, could increase their activities and could prolong life. However, he had insisted that to get good results in these cases, the antispecific remedies must be administered according to a definite plan, which had proved satisfactory in his experience and which he believed was applicable to all cases of tertiary syphilis.

The plan was as follows. To give potassium iodide and mercury for from four to six months before any salvarsan was given. Thus the gummatous infiltration in the aorta was first controlled, which preliminary preparation seemed to give an especial impetus to the action of the salvarsan, since when the latter was then given the improvement in the symptoms was marked, cough and tracheal obstruction were lessened, pain could be expected to disappear, and the patient became possessed of a sense of well-being and acquired a capacity for greater physical effort. Potassium iodide was given in doses of ten grains three times a day and mercury generally by injections of the salicylate not to exceed one grain every five days, interrupting these drugs as occasion required. Before giving salvarsan the potassium iodide must be stopped, since, when potassium iodide had been given following salvarsan, it had seemed sometimes to have caused pain, and, even for months afterward, to have been particularly prone to excite cough. Potassium iodide appeared to supply a real want in the early treatment of thoracic aneurism, but when it had once been given for a long period of time prior to the salvarsan, as here recommended, any subsequent usefulness of this drug had seemed problematical. It had seemed very important that mercury be given between the doses of salvarsan, to the beneficial effects of which thus administered the patients themselves would bear testimony. The salvarsan, or diarsenol, 0.3 gram was given about once a month, being guided as to the number of injections partly by the Wassermann reaction and partly by the effect of the treatment on the control of the symp-

toms and on the activity of the patient When, with a lapse in treatment of a thoracic aneurism, symptoms recurred for which further treatment became necessary, it had seemed best to administer mercury alone for a while before giving the next dose of salvarsan Mercury should not be given within five days before, or five days after, salvarsan The urine should be watched

More lasting benefit in the treatment of tertiary syphilis had seemed to come with the use of old salvarsan or diarsenol, consequent upon a preliminary treatment with potassium iodide and mercury, than with neosalvarsan (*vide* cases 1 and 3)

Cases of thoracic aneurism touching the chest wall, which were suitable for treatment with the antispecific remedies alone without wiring, were those without much recess formation in their contour, indicating an absence of great stretching with thinning of the aneurism wall in any particular locality

CASE I—V K, age thirty-seven, laundress, referred through the courtesy of the late Dr. A. A. Smith, at Bellevue Hospital Onset in January, 1914, with pain, which became severe, but the following June disappeared, leaving a soreness. In March, 1914, she lost her voice, and the following August she had her first choking attack in which her throat was full of "rattles," evidently a bronchorrhœa, which was relieved by a hypodermic injection She had six of these attacks before entering Bellevue on September 29, 1914, where she was put to bed and given potassium iodide in moderate doses and injections of mercury salicylate In December, two weeks after an interruption of her potassium iodide, she developed a very bad attack of obstructed breathing with bronchorrhœa, but on giving potassium iodide again in ten-grain doses, the acute symptoms left After her preliminary treatment with potassium iodide and mercury she was given in the spring of 1915 four injections of neosalvarsan 0.45 with mercury salicylate in between She left Bellevue July 4, 1915 Wassermann, September 30, 1914, six units, January 30, 1915, fifteen units, the following June 9, two units, and August 18, negative In August, 1915, she was able to walk three

blocks before she would have an attack of hard breathing, which latter would disappear on resting She had regained her voice During that summer she gained twenty pounds, but her health continued precarious, and in the fall she began to have dyspnoic attacks again, with pain and throbbing, irrespective of exertion Potassium iodide in five-grain doses now increased her cough and expectoration, and after a short trial was discontinued She was given a few injections of mercury. On November 22, 1915, she had a severe attack of tracheal obstruction, and she re-entered Bellevue Hospital Wassermann, fourteen units Potassium iodide, tried again, once more increased cough and expectoration and had to be stopped She was given injections of mercury salicylate, under which she improved so that she was able to walk about the ward without distress in breathing. On January 18, 1916, she caught cold which was followed by a series of attacks of labored breathing from pressure on the trachea, accompanying which the superficial

veins on the front of the chest would become distended. It was found that these attacks of shortness of breath would become relieved in a few minutes accompanied by a diminution of expectoration and cough, following a hypodermic injection of ten minims of adrenalin. The blood-pressure was low. Between January 22 and 29 it varied from 105 to 118. A few doses of 1/150 grain atropin were also given and the patient improved somewhat. Marked improvement, however, followed the giving of a dose of neosalvarsan 0.45 on January 29. Just before receiving this medication the only position in which the patient could sleep was on her back with her head turned to the left side. Any attempt to lie on either side would produce hard breathing and choking. On January 30, the day following the giving of the neosalvarsan, the patient passed a very comfortable day and slept the greater part of the ensuing night. On January 31 the patient coughed but little and began to rest some on her sides, and by February 5 she was able to rest with comfort on either side.

The patient continued to improve. On March 17, 1916, she was given diarsenol 0.3, and on May 4 she was given of the same drug, about 0.24. She left Bellevue the middle of May, at which time she could walk and stand around the ward a good deal of the time with perfect comfort. She then had no shortness of breath unless she hurried. She could sleep in any position. She coughed very little. During all of this time that she was in the hospital she received mercury either in the form of the salicylate or by inunctions. She has a peculiar reflex, in that whenever she gets an injection of mercury she immediately becomes nauseated and remains so for from twenty-four to thirty-six hours.

Since the patient had the diarsenol in the spring of 1916 up to the present time she has had no serious relapse. Once last November she caught a cold which was accompanied by a little shortness of breath, but this soon disappeared. On Labor Day she walked twenty blocks without any ill effects. She has been employed during the winter as secretary, at which occupation she works from two to six hours a day. She walks generally four long blocks a day and climbs two flights of stairs to her room. She has had no chronic cough since last spring. Two days ago, wishing to indulge herself in a long walk, she covered in different stages about two and one-half miles without any trouble. She occasionally sings in the choir. She has taken some mercuric potassium iodide pills, one-sixth of a grain during the fall and winter. Wassermann, taken on November 14, 1916, was five units, cholesterin antigen. An X-ray taken February 26, 1917, compared with one taken May 8, 1916, shows that the transverse measurement of the aneurismal shadow has not changed.

*Observations*—After this patient had been given neosalvarsan, whenever resort was made to potassium iodide, the latter always aggravated her cough, so that finally it was stopped, and afterward she made her final recovery with mercury in combination with one injection of neosalvarsan and two of diarsenol. While the patient made

some temporary improvement following the four injections of neosalvarsan given in the spring of 1915, the beneficial effects of this drug were not lasting, her health continued to be precarious, and before long she suffered a serious relapse. Since she has had the two doses of diarsenol last spring she has not had any serious relapse (now nine months), and she has had much more activity and comfort than she had before and has been able to enjoy life. It does not seem possible that the patient would have reacted from her condition of very acute tracheal obstruction in January, 1916, without the magical influence of the neosalvarsan, coming as it did in sequence with her prior anti-specific medication.

In explanation of the sudden attacks of tracheal compression which occur in these cases with relief following a hypodermic of morphine and atropin or of adrenalin, the writer has stated elsewhere<sup>1</sup> his belief that they are due to a mediastinal oedema.

CASE II—H. W., age forty-six, druggist, even enlargement of aortic arch. Onset with cough in December, 1914, followed by pain on exertion, slightly harsh breathing characteristic of a mild tracheal obstruction, and slight huskiness of the voice. There has never been any pulsation which could be felt transmitted through the chest wall. Beginning July 2, 1915, up to February 15, 1916, he was given five injections of salicylate of mercury of one grain each, four injections of three-quarters of a grain each and twenty-nine injections of one-half a grain each. For five months prior to December, 1915, he took potassium iodide in ten-grain doses with an occasional short interruption. In December, 1915, and January following, resort was again had to potassium iodide in five-grain doses on two occasions, but both times the cough became so aggravated that this drug had to be stopped. This was before any salvarsan had been given. It has seemed that when potassium iodide has been given over too long a period of time, even though salvarsan has not been taken, cough will result, as if to express that the limit of tolerance to this drug had been reached. On February 25, 1916, the patient was given neosalvarsan 0.45, and since that time he has been given diarsenol 0.3 four times, 0.2 once and 0.25 once, with thirty-three injections of salicylate of mercury one-half a grain each and mercurial inunctions for six weeks during the early part of the summer. On August 29, 1916, his Wassermann was fifteen units positive cholesterin antigen, and +++ alcohol antigen. On December 20, 1916, his Wassermann was 10 units positive with cholesterin antigen and negative with the alcohol antigen, this reduction in the strength of the Wassermann reaction having followed the giving of 3 injections of diarsenol 0.3 at intervals of a month, with injections of mercury salicylate once in five days between.

This patient has never suffered very acutely. His activities were limited for a long time by the occurrence of pain and shortness of breath on exertion. He consequently was inclined, while thus affected, to stay in his room. The cough has been the thing that has been promi-

<sup>1</sup> ANNALS OF SURGERY, LXIV, 1916, p. 691



nent in his case and that has not generally been very distressing. It has been for the most part dry and evidently of a reflex character since it has been influenced by the position of the body. Up to early in January, 1917, if he would lie on his back or his right side he would cough, but he could lie on his left side without coughing. Latterly he has been able to lie in any position in bed without coughing. Up to the time of receiving his neosalvarsan on February 25, 1915, the patient had improved to a certain extent but his activities were very limited. The huskiness of his voice had disappeared. With the subsequent treatment with neosalvarsan, diarsenol and mercury the patient has gradually gained in strength and activity, and his symptoms have almost entirely disappeared. The patient has walked about three miles comfortably on each of the past three Sundays. Since stopping his antispasmodic treatment on January 8, 1917, he has since improved a good deal. At the present time he coughs but little and that only in the morning on rising and when he moves about. His breathing is a little hard only when he walks uphill. He is working again about three hours a day. Following the neosalvarsan and each injection of the diarsenol the improvement of the patient was quite noticeable and the patient always claimed that after each injection of mercury given in between times he likewise experienced a certain benefit. It was following his last injection of diarsenol on December 20, 1916, that he claimed to have been partially relieved of a feeling of pressure in the head and neck which the previous injections of this drug had not done, and that he breathed a great deal easier. X-ray pictures of this patient taken at the beginning of treatment and before and since neosalvarsan and diarsenol have been given show that the size of the aneurismal shadow has remained the same.

CASE III—B F, aged 43, aneurism of left dorsolumbar region. Referred by Dr S Bradbury. Pulsation distinct though not forcible over region of eleventh and twelfth ribs about 2 inches from the vertebral spinous processes. Pain in the left side has been the prominent symptom. The patient sought hospital relief in December, 1913. In the hands of others within the first six months he states that he was given six injections of neosalvarsan and a great deal of potassium iodide. At the end of this treatment he stated that he had not been relieved of his pain at all. Thus from the writer's standpoint the treatment of this case was begun quite contrary to what might be expected to produce a satisfactory result. In the summer of 1914 he came into the writer's hands. He was suffering pain which prevented him from standing or sitting erect. He was given mixed treatment for about ten weeks with some relief for a while, but with later intensification of the pain. Then between October 21, 1914, and February 3, 1915, he was given 6 injections of neosalvarsan 0.45 and 16 injections of mercury salicylate. After each injection of neosalvarsan there would be some relief to the pain with more or less return of it soon after. In March and the first half of April, 1915, he was entirely free from pain but afterward the pain began to return. At this time he had not been working and had done little walking. He then went

into other hands again and was given considerable potassium iodide which did not help his pain any. The middle of August, 1915, he was again seen by the writer. With slight exertion he would have pain in his left groin and inner side of left thigh. Wassermann negative. He soon disappeared again and turned up August, 1916. For nine months previous to his return he had taken 5 drops of potassium iodide three times a day. Though there had been some variation in the amount of pain, he had had very little relief throughout the year.

What seemed finally to have given this patient more lasting relief from his pain under conditions of limited activity than had any of his former medication, was an injection of diarsenol 0.3 given on September 25, 1916, which was preceded by, and followed by, 5 injections of mercury salicylate grain I. The immediate improvement following the diarsenol injection was much more marked than had that ever been following an injection of neosalvarsan. The patient then left town and was not seen again until February 21, 1917, when he reported that since the end of October, as long as he had been inactive, he had not noticed the pain, which had been inconsequential. He could walk one or two blocks slowly without exciting pain. He could stand perfectly straight. He could sleep in any position. Pulsation was now difficult to detect. This experience would argue in favor of a preference for diarsenol to neosalvarsan. It is of interest that the Wassermann on September 18, 1916, was only 1 unit positive with cholesterin antigen, yet the symptoms, at that time uncontrolled, became greatly relieved following the giving of the diarsenol in conjunction with mercury.

Just after rendering the above favorable account of himself, while returning home in a trolley car, for no assignable reason, the patient had an attack of pain as formerly, which disappeared after a considerable rest, since which time the pain has recurred with only slight exertion such as walking around his room, and he can now lie only on his right side with comfort. The pain is however not so great as it used to be. It now passes around both sides of his body. There is no evidence of physical change in the aneurism.

CASE IV—W. H., age 58, laborer, referred by Dr. E. M. Raynor. Admitted to Bellevue Hospital October 19, 1916. Mesial thoracic aneurism of arch extending upward laterally to beneath the right clavicle and projecting prominently above the sternum, besides bulging to the left. In February, 1916, a lump began to grow in the neck and hoarseness developed. He had been short of breath on doing hard work and walking upstairs for about a year. If he lay in bed on his left side he would cough and have pain. When up, pain was excited only by working. Not much expectoration. Taking it easy he could walk about a mile without trouble. Some dysphagia. Would cough considerably on drinking water. Wassermann 15 units cholesterin antigen and ++++ alcohol antigen.

*Treatment*—Since the patient has been in Bellevue Hospital he has had 9 injections of mercury salicylate of 1 grain each and 11 injections of  $\frac{3}{4}$ -grain each. He was at first given potassium iodide in 10-grain doses for about ten weeks and a comparison of the X-rays

taken before and after showed no perceptible change in the size of the tumor. Then wishing to determine whether potassium iodide given in increasing doses might not diminish the size of this aneurism, on January 9, 1917, this medication was started, and, increasing the dose 3 grains each day, the potassium iodide was run up to as high as 82 grains three times a day. When this latter medication was started the patient was recovering from an acute cold so that he was then coughing more than usual. The cough continued during the time of taking the intensive doses of potassium iodide with greater severity than ever before, and finally it became so bad, keeping the patient awake, and the nose ran so profusely, that this drug was stopped, following which the cough soon entirely subsided excepting when he drank water. An X-ray taken about three weeks after stopping this heavy dosage with potassium iodide showed no evident change in the size of the aneurismal shadow. At the present time swallowing is easier, he does not cough so much when he drinks, and the voice is much stronger, the latter improvement having taken place particularly since about the middle of January. He walks around the ward with a good firm tread, but gets short of breath if he hurries too much.

*Observations*—This patient was presented at the end of his iodide and mercury treatment to emphasize the fact that this preliminary treatment with the older remedies should precede the giving of old salvarsan or Arsensol. Also to demonstrate the results of this preliminary treatment, *viz* No apparent change in the size of the aneurism, indicating that at least growth had not taken place, besides considerable improvement in general health, yet without restoration of much activity and vim, which latter would now be expected to supervene in this case with the giving of old salvarsan supported with mercury. (A Wassermann taken March 7 was still 15 units and + + + +) Added severity of the cough and coryza produced by the giving of large doses of potassium iodide are conditions which must be very undesirable in a case of this sort, both from the extra strain put upon the diseased aorta as well as from the loss of sleep entailed. This case, with its extensive recesses on either side and upward, is one for which the wiring operation would seem to be indicated in the near future.

DR WILLY MEYER said that a review of the means at the surgeon's disposal for the treatment of aneurism showed that they had nothing else so far that showed somewhat permanent results except antispecific treatment in combination with wiring.

The one case reported by Dr Lusk, who has lived four years up to this time, is most striking and most instructive. The speaker could recall one case seen by him, who was afterwards wired in Baltimore. The man lived for a year and one-half afterwards in apparently good health. Another case, a man above fifty years of age, who was absolutely bedridden on account of a large aneurism of the ascending aorta, was wired by Doctor Meyer in 1913 at the German Hospital. That man was very much improved so that he was able to walk upstairs, four flights, to his bedroom. He lived

## ENUCLEATION OF CLOT IN HEMIPLEGIA

almost one year, when he died suddenly while talking to his wife. In another case, which was subjected to wiring about one year ago, the man lived for eight or nine months. The postmortem showed that comparatively little wiring had been introduced into the anterior portion of the sac. He had seen cases where very small aneurisms had occasioned great trouble. He had had under his care two men who had died from suffocation, in each of whom at autopsy a very small aneurism was found which compressed the trachea and one bronchus. How can one help such cases in which only radiography can establish a definite diagnosis? For wiring, the sac must be adherent to the thoracic wall at least in one place. In a case of this type, in which the X-ray showed an intrathoracic tumor, but which was nowhere adherent to the chest, he opened the thorax and found a place where it was adherent close to the spine. Upon the skin over this point a mark was made with a knife and the wound was closed. This preliminary procedure was conducted under intratracheal insufflation of ether. He developed pneumonia, from which he died, so that they did not get so far as to wire him.

Since having seen Dr. Lusk at work, he had admired especially his patience and perseverance. To prepare the wire takes a long time in order that the coil may assume the same size inside the sac, after it has been passed through the needle, as it had outside. Dr. Lusk uses his fingers and works and works for hours, for days often, until he has brought the thirty or thirty-five feet of wire to that condition which will cause it to keep the desired coil.

Dr. Meyer in his second case, about one year ago, having seen the amount of work required felt unwilling to impose upon the kindness of his colleague to help him again prepare the wire, so he consulted a dentist friend who was an ingenious man. He, Dr. Kauffer, suggested to wind the wire around a bottle of the desired diameter, which had been covered with asbestos to protect the glass. Then he passed an electric current through it, governed by a rheostat, in a strength just enough to make a cherry-red heat. After the wire has cooled off, when it is taken from the bottle, it will hold its size absolutely, it can be drawn up or down or treated in any way, and it retains the coils desired. This is quite an advance technically because if the hospital has many of these cases the house staff will be kept very busy to prepare the wire after the old plan. The electric current does not interfere with the strength or the resiliency of the wire. The wire costs about one dollar per foot.

## ENUCLEATION OF CLOT IN HEMIPLEGIA

DR. ALFRED S. TAYLOR referred to the article of Hudson, published in 1913, *ANNALS OF SURGERY*, LVII, 492, on the treatment of hemiplegia, in which he advocated the procedure to enucleate the clot from the internal capsule, thereby sometimes saving life in the extremely acute cases, and in any case hastening the recovery. Since in any hemiplegia the damage is of two types, the permanent paralysis due to the actual amount of brain tissue destroyed

by the rupture of the vessel and the secondary damage which is due to the pressure of the blood clot upon surrounding structures, it seems reasonable to infer that if the clot could be evacuated recovery would necessarily be more rapid and more complete. He had tried to get some early cases, but had succeeded in getting only one. However, he had had two or three of the older cases in which the results had been interesting, and, in illustration of the result of the attempt to treat hemiplegia in that way, he presented a girl, 16 years old, who in October of last year, 1916, fell upon the street and was unconscious for three hours. She was taken home and after three days was taken to Willard Parker Hospital as a suspected case of poliomyelitis. It was noted, however, that she had a left hemiplegia. At that time, in Willard Parker, a Wassermann on the blood and the spinal fluid was negative. She was discharged from the hospital after about two and a half months with a well-marked hemiplegia.

On January 8, 1917, she entered the Hospital for Ruptured and Crippled. Her systolic pressure was 115 mm and her diastolic was 85 mm. The urine was normal, nothing could be found in the heart or lungs that was abnormal and no cause could be made out for the occurrence of the hemiplegia. The eye grounds were normal, the blood Wassermann was negative, the spinal fluid was clear, showed one cell to the field, and contained no globulin. Spinal fluid Wassermann was negative.

The left side of the face showed distinct weakness, least noticeable about the eye. The left triceps, biceps and wrist reflexes were markedly exaggerated. There was distinct loss of power in the left upper extremity but not complete paralysis. There was marked spastic contraction in the elbow, wrist and fingers and it was difficult to straighten the joints without the use of undue force. Attempts to elicit the knee-jerk in the left side caused patellar clonus, which was rapid and persistent. Ankle clonus was present but not marked. Babinski suggested in the left foot. The tongue deviated slightly to the left. There were no sensory changes.

On February 8, 1917, operation under ether was done at the Hospital for Ruptured and Crippled. A right-sided subtemporal decompression was done. The bone was removed over an area about 7 x 5 cm. The dura was tense, but pulsation could be made out. The dura was split by a crucial incision and the brain immediately protruded 1 cm. The brain surface was markedly congested and the pia-arachnoid was cloudy. The veins in the sulci were distended.

Palpation revealed no localized resistance.

A Cushing needle was passed perpendicularly into the first temporo-sphenoidal convolution 1 cm behind the lower end of the fissure of Rolando. At a depth of 1.5 cm it encountered increased resistance and after being pushed in slightly farther it evacuated a fluid which was more viscid than ventricular fluid and somewhat yellowish, soon becoming blood-stained. While waiting for a sterile tube the flow ceased. The needle pushed in slightly further evacuated about 6 c c of ventricular fluid.

The needle was withdrawn and through the same cortical puncture was passed in an upward direction at an angle of 45 degrees. The same increased resistance as before was noted at a depth of about 1.5 cm and persisted until the needle had been inserted an additional centimetre. No fluid was evacuated this time.

The needle was withdrawn and along its track was inserted an endoscope 22 Fr into the indurated area. The obturator was withdrawn and an electric light attached. The tissue at the end of the endoscope was dead white. There was no bleeding, but at the end of a few moments a thin blood-stained film covered the exposed surface. The tissue showed no tendency to crowd up into the lumen of the tube in spite of the increased brain tension previously noted. Inspection continued while the endoscope was withdrawn, and where the indurated tissue ceased at about 1.5 cm below the cortex, the brain substance became more vascular.

The dura was left wide open, and the remainder of the wound closed by layer sutures of catgut, chromic gut and silk. She left the table in good condition and at no time had shown any signs of shock or depression. The maximum temperature after operation was 99.6. The wound healed by primary union.

February 10 (2 days after operation) the arm, wrist and hand fall straight out on the bed from their own weight. The spasticity is entirely gone. She can voluntarily flex and extend the elbow, wrist and fingers, although there is not much power. The exaggerated reflexes at the triceps, biceps and wrist have disappeared. In the lower extremity the knee-jerk is still much exaggerated but the patellar clonus has disappeared. There is no ankle clonus.

DR TAYLOR presented also a man who had been under treatment at the Fordham Hospital. He had had a sudden hemiplegia, suggesting a hemorrhage in the internal capsule. As a matter of fact, it turned out afterwards that his primary attack, which began on the first of March, 1916, had been preceded by a gradual loss of the use of his right upper and lower extremities. In other words, it had been a gradual, progressive hemiplegia.

At last he became unconscious, developed motor aphasia and complete loss of power of the upper and lower right extremities. On April 5, 1916, five weeks after his hemiplegia, an exploration of his left motor cortex was done because of his hemiplegia and aphasia. No increased pressure was found, but rather a diminution in cerebral pressure. At the site of the speech area the brain was distinctly soft, and on puncturing it with the aspirating needle a fair amount of what looked like melted fat exuded. Of course there was nothing further to do. They had a decompression already, and simply closed the wound expecting to get little or nothing as a result.

However, very promptly after the operation he began to improve in a number of ways. Before operation any attempt at speech, no matter what he wanted to say, simply resulted in blub, blub, blub, blub. After he'd do that for a moment or two he'd start to cry because he couldn't express himself.

Before he left the hospital, which was only three or four weeks following his operation, he still could not speak, but he could almost articulate. He was

approaching the time when he could speak. He has been at the Montefiore Home since and has learned to walk fairly well and Dr. Strauss, on whose service he is, reports that he can talk moderately well.

### CARCINOMA OF THE THYROID

DR. JOHN ROGERS remarked that cancer of the thyroid had been, in his experience, comparatively rare. He had records of only about one dozen cases. Three of these were in people under thirty years of age. The disease has, in each instance, presented quite definite characteristics, and there were two varieties. In one, the carcinoma seemed to have developed extensively throughout the greater part of a long-standing simple goitre. In the other group it apparently originated and remained in some localized portion of an otherwise healthy gland.

In the first group, with diffuse thyroid involvement, the lymphatics became enlarged early and were hard like the primary tumor, which was always hard and nodular and painful, but not tender.

In the second group, with the cancer well encapsulated and sharply definable from the surrounding normal gland tissue, the disease has felt very hard and nodulated, and the lymphatics have been involved very late. More or less pain has been noticeable.

He then presented a man thirty years of age, who first noted a tumor low down in the left side of his neck last fall. Within the last four months it increased quite rapidly in size until at the time of operation, February 11, it was about three inches in diameter. The pre-operative diagnosis was probable carcinoma of the thyroid.

The excision of the tumor through a transverse incision was carried out under local anæsthesia ( $\frac{1}{2}$  per cent cocaine) without difficulty. The tumor was surrounded by a dense capsule which enabled it to be readily trimmed out of the lower pole to the left thyroid lobe. The remainder of the gland appeared perfectly normal both to sight and touch, and no lymphatic enlargement could be detected, and, therefore, the apparently sound thyroid gland was not disturbed. Only the diseased portion was excised, and that, too, quite close to its dense fibrous capsule.

He believed the tumor to be cancer at the time of operation, but did not think excision of the whole gland was justifiable (a) because the disease seemed entirely confined to the tumor and (b) because if it had escaped into the gland it had just as probably escaped into the general circulation. Fortunately, the final report of the pathologist, though not quite definite in some respects, is quite definite against the presence of true cancer.

### CORNEAL ULCER OF EXOPHTHALMIC GOITRE

DR. ROGERS presented a second case to show a rare and disastrous consequence or complication of the exophthalmos of Graves' disease. It is instructive in illustrating the treatment which, to succeed, must be prompt and

thorough. He first saw him on January 19, 1917. The man then had a rather low pulse rate (of 100-120) for the severe grade of this disease. The mentality was sluggish instead of excited, and there was a tendency to stupor. The goitre was small and firm, the blood pressure 110, and there had been a loss of thirty pounds in weight during the previous six weeks. The exophthalmos was extreme, and an ulcer had developed over the left pupil. This was accompanied by great œdema of the conjunctiva, which protruded through the palpebral fissure and forced the lids apart. The right eye was inflamed, and was somewhat insensitive to touch, but showed no ulceration. As he had found it possible to produce an appreciable enophthalmos by section of a filament of the sympathetic which crossed the inferior thyroid artery (provided the filament was found), he exposed on January 20, under local anæsthesia, this artery by a vertical incision along the lower part of the posterior border of the sternomastoid muscle. He tied and cut the artery, and sectioned all the filaments of tissue which lay in its neighborhood and resembled a sympathetic nerve fibre. The condition of the patient seemed so precarious that he had to finish the operation without attempting the same thing on the other side. The resultant effect was negative. He was placed upon a few drops of an extract of the whole adrenal gland every three hours, as he had found this sometimes beneficial. The right eye then began to show conjunctivitis, and on February 2, 1917, under local anæsthesia, he attempted to section, as on the other side, the lower cervical filament of the sympathetic and at the same time tied the right inferior thyroid artery. The resultant enophthalmos was just appreciable, and by no means enough to prevent the development of a corneal ulcer. A day or two later the ulcer seemed worse, and the conjunctiva began to be œdematous. If this continues, and the lids cannot be closed, sloughing is almost certain to follow and destroy the eye. Consequently, on February 6, under ether, he made a curved incision concavity backward, along the anterior margin of the temporal and zygomatic fossæ and through this opening chiselled away the whole of the outer wall of the orbit behind its anterior margin. After incision of the orbital periosteum and fascia, the orbital fat protruded into the zygomatic fossa like a hernia cerebri out of the skull. It showed the tension which existed behind the eyeball. Even this lessening of the orbital contents did not permit a complete closure of the eyelids. After suturing the skin and fascia so as to close over the temporal fossa, he then sutured together the eyelids, and afterwards found this made so much pressure upon the eyeball that six hours later the sutures had to be removed. He next quickly exposed by a transverse incision, and ligated, the upper poles of both thyroid lobes. The next day the conjunctiva had become so œdematous that the lids were forced wide apart. An attempt was made to prevent sloughing of the cornea by the application of vaseline, but it seemed hopeless. On February 12, Dr Knapp made another and more successful attempt to close the eyelids. Under ether he split, longitudinally, the apposed edges of the lids on the conjunctival side of the eyelashes. He then cut through both eyelids nearly to the conjunctiva,



along the upper and lower margins of the orbit. These liberating incisions then allowed the lids to be held in apposition with mattress sutures, which approximated the split raw edges of the eyelids. Union has taken place enough to protect the cornea and yet allow space to instill a wash to cleanse the ulcer.

At present it looks as though the upper half of the right pupil might be preserved for sight. This case teaches the necessity of prompt action. As soon as œdema of the conjunctiva appears, the outer wall of the orbit should be excised and in addition the eyelids should be freshened along the margins and sutured together. Tension must be prevented, and can be relieved by liberating incisions through the lids along the edges of the orbit.

Excision or section of the sympathetic has but slight, if any, effect in decreasing the exophthalmos. Suture of the lids has often been condemned, but it is an indispensable procedure when liberating incisions make it free from tension.

#### FACTORS BEARING ON THE MORTALITY IN OPERATION FOR BILIARY OBSTRUCTION BY CALCULUS

DR. FREDERICK T. VAN BEUREN read a paper with the above title, for which see page 169.

He said that the paper had been written because all statistics need a certain amount of explanation. It is not a fair thing to take any set of statistics and compare them with any other set unless one knows the details of the operations from which the statistics were made, and when in Dr. Matthews' article the statistics of the Roosevelt Hospital were compared with the statistics from the Mayo Clinic and Dr. Erdmann's, it made it look as if the Roosevelt operations were very much more fatal than the others.

As a matter of fact, he could not by any means find that that was so, and, after finishing the investigations of their own cases, up to two years ago, he looked over the article by Dr. Mayo and found that they had followed out all the recommendations that he made to safeguard operation in this condition, with one exception, and that was that they did not examine the stools every day for bile until it was found that there was bile in the stools. He considers that a very desirable thing. Where cases have been watched outside for months and even for years—some of them twenty or thirty years, as some of these cases had been—it doesn't pay to watch them for very long in the hospital to see whether they have bile coming through with their stools or not, and as to bile in the ducts, one cannot tell until one operates whether there is bile in the ducts or not.

In analyzing Dr. Mayo's statistics, one finds in his cases that had jaundice the death rate was 10 per cent, and in those cases where complete obstruction was present, their death rate was 25 per cent. All cases reported in the present paper were of these two types. The total death rate, of 492 cases, was pulled down considerably by the fact that, in those cases where

## BILIARY OBSTRUCTION BY CALCULUS

there was no obstruction and where the calculi were discovered at operation in the common duct, the death rate was only 3 per cent

In Dr Erdmann's article there was nothing enlightening in this particular regard, and it is only fair to insist that the mortality depends largely on the condition of the case when it comes to the surgeon and the complications that occur. The complication they found occurring for the most part fatally was pneumonia—four out of nine cases had definite signs and two others had very suggestive signs of pneumonia. That is, six out of nine cases died with pneumonia, whether of the pneumonia or not. The pneumonia, of course, being a terminal type, was probably due to the fact that their condition was so reduced that they couldn't stand the extra amount of strain on their resistance that came inevitably with the operation.

DR CHARLES H. PECK said that the mortality depends largely upon the amount of obstruction present, the pre-operative complications and the general condition of the patient, aside from the ordinary operative accidents of any group of very ill cases. If one could select a series where the obstruction had been short in duration or where the stones were found accidentally at operation for an ordinary gall bladder condition and the patient was not depleted and had no pre-operative complications, the mortality should be very low. The average surgeon sees a good many cases of common duct stone operated upon without trouble and without mortality.

In the desperately ill cases that have had prolonged jaundice or prolonged sepsis in the form of cholangitis, the resistance is greatly lowered and some will, from one complication or another, not survive the operation. The cases that are the most difficult are the secondary operations. In addition to the ordinary difficulties one has the operative adhesions to deal with, involving often a difficult and prolonged approach to the common duct before one can begin to do the work upon it.

He had been unfortunate enough to have two such cases during this past season. One had, following cholecystectomy, biliary obstruction for over six months with persistent and increasing jaundice. The attempt to find the cause of the obstruction proved very difficult. The biliary duct was stricture, and following it up to the liver and the cicatricial tissue seemed to run into both radicals of the hepatic duct and he failed to find a dilated duct which could be drained above the cicatrized portion. The patient died five days after the operation, from oozing and hemorrhage, the result of the persistent jaundice.

Another unfavorable result he had had during this past season was in an obstructive case with a lesser degree of jaundice and persistent recurring pain, a patient who had had two operations in the preceding fifteen months, the exact nature of which he could not find out. At the third operation, which he performed, he found the gall bladder absent, a very dense mass of cicatricial tissue all about the duct, an extremely difficult approach, two moderate-sized stones impacted down in the region of the papilla, requiring a transduodenal choledochotomy, after which he was able to get a probe well up in the duct.

and relieve the obstruction This patient was sixty-eight years of age, a feeble old man much depleted by his former illness, but in spite of that Dr Peck was rather hopeful that he might survive the ordeal, and he believed he would have done so except for an unusual complication About three or four days after the operation there was a leak in the duodenum The leakage was so profuse that he thought the suture in the duodenum had given way, and feeling that the consequences would certainly prove fatal, he made an attempt to close the fistula It was not in the suture line, it was about half an inch back of it He could see it distinctly, a round opening which would admit the tip of a lead pencil, and he attempted to close it, but on account of the inflammatory tissue was unable to get a very satisfactory closure, but a flap of tissue and pressure of the drainage tube secured a partial closure of the opening The patient died from exhaustion following the two operations added to the leakage of the duodenal fistula

He mentioned these cases as two that would be recorded fatalities from bile duct obstruction, but which could hardly be fairly included among a group of cases of primary operation for common duct stones, because both presented unusual difficulties which he was unable successfully to overcome

It is an extremely important group of cases, in the routine, ordinary case the mortality should be low Taking the cases as they come, with pre-operative complications and the debilitated, feeble, old patients that one meets with in the average hospital service, the operative mortality is bound to be fairly high if all cases are reported.

DR JOHN DOUGLAS said that it seemed to him that another element not mentioned by Dr Van Beuren should be considered as affecting operative mortality, *viz*, the kidney function at the time of operation Within the last year he had lost two cases of stone in the common duct, one in a woman sixty-eight years old and another in an older woman, and in neither case was the operation a particularly long one or particularly difficult technically In both cases the urine was diminished the day following the operation with complete suppression within forty-eight hours

This is a factor in the operative mortality in these cases, whether due to the anæsthetic alone, or that the anæsthetic adds sufficient irritation to the already damaged kidneys to cause a complete suppression, and must be considered in giving a prognosis

DR JOSEPH WIENER said that a number of years ago he looked up the mortality after operations on the biliary tract done by different surgeons in one hospital He had gotten the idea in his mind that the time occupied in operation had a good deal to do with the mortality A number of years before that he saw Dr Hans Kehr operate on three cases in this city, each operation took an hour and half and all three patients died All three patients had normal pulse and temperature before the operation, none was severely ill, all should have given a good prognosis

As he had watched cases done by different surgeons he had noticed that the patients who were on the operating table over three-quarters of an hour

were those that not necessarily had increased mortality but increased morbidity. He then looked up a large number of cases and was struck by the fact that certain cases died pretty regularly, *i e*, those that were on the table more than an hour and a quarter.

Since then he had always considered the time occupied in operation a fact of a great deal of moment. Of course the time of operation means the time of anæsthesia. When one looks up the cause of death in these cases one finds nephritis, pleurisy, pneumonia—all three of those complications are at least in large measures due to anæsthesia. If one could do these operations under local anæsthesia one would see little acute nephritis, practically no pneumonia, and very little pleurisy.

The handling of the gut required in these cases also plays an important part, and the incision of Sprengel may give maybe not less mortality but certainly less morbidity.

About a year ago he had under his care a gentleman with biliary obstruction who was a very bad risk on account of the condition of his heart, arteries and kidneys, and he decided to do part of the operation under local anæsthesia, with the Sprengel incision. That incision, if made carefully, takes almost fifteen minutes. As soon as the abdomen was open the man received gas and oxygen for about fifteen minutes while the gall bladder was being removed, and then it was stopped and the abdominal wall sutured. He made an uneventful recovery.

If such a course could be followed in more cases he thought there would be less trouble after operation. As to the coagulability of the blood, in jaundice cases he had made it a rule for years not to operate until the time of coagulation was determined, and if the coagulation was over seven minutes to give the patients a preliminary treatment of one of the calcium salts. He had found the calcium lactate and calcium chloride very useful. The calcium chloride is used in large doses but the calcium lactate should be given in small doses, from five to ten grains. In that way he had been able in forty-eight hours to reduce the time of coagulation from ten or eleven minutes to five or seven minutes. In several cases he had injected blood serum before operations. He had used ordinary antitoxin, which is, of course, made with horse serum.

In postoperative hemorrhage there is a drug, or rather a patent preparation, known as coagulose, which he had found extremely valuable. He had used it in four or five post-operative hemorrhage cases, not all biliary cases, and in every one the bleeding had stopped. In one case he used a preliminary blood transfusion and the patient's general condition improved and she recovered from the operation. He thought the blood transfusion had something to do with it.

He had had two unfortunate experiences in duodenal leakage similar to Dr. Peck's. Both patients died. In both cases the leakage was at the suture line, and both patients died of starvation.

DR. ELSWORTH ELIOT, JR., remarked, in regard to the mortality of opera-

tions for cholelithiasis, that much depends upon the condition of the circulation and kidneys. Much also depends upon the degree and length of obstruction, and in these cases in which obstruction has existed for some time, a considerable mortality is due to an ascending infectious cholangitis terminating in small, if not actually microscopic, diffuse abscesses in the liver parenchyma.

DR CHARLES N DOWD said that the consideration of this series of cases brings up various topics which are important in New York surgical work, for a large proportion of cases seen in metropolitan hospitals are extremely bad risks. Their internal organs are diseased, they are old, they have all sorts of complications, and are mentally and physically exhausted.

One may follow one of two courses—either try to give them the possible benefit which surgery offers, or simply refuse to accept them as surgical risks and let them go to their fate, whatever that may be.

Most surgeons feel that these people have a just claim for help and that too much regard to our operative statistics in trying to relieve them should not be entertained. The subject was brought strongly to his mind early in the winter when he operated for a small cancer at the margin of the second breast. The first breast had been removed for cancer three years earlier. The patient made an excellent recovery, and, as she was starting homeward, her husband stated that operation had been refused to her at a very good surgical clinic, yet operation has promoted her comfort and will probably prolong her life. She had a certain claim on surgery, and those institutions or surgeons who are so situated as to meet these undesirable surgical risks will, of course, have poorer statistics than those who have better selected clientele.

There is, however, an advantage in having statements of the results as they are obtained under these disadvantageous circumstances, and there is a decided advantage in having the statistics of all the operators of hospitals published as a unit instead of having statistics from individual operators on selected groups of cases. Dr Van Beuren's group represents the work of six different operators who accepted risks which they knew were grave. By the publication of both varieties of cases the matter is put in a fairer way before the profession, and men are less likely to be misled in prognosis.

Another element may be noted about this particular group of cases. In the entire nine cases, only one autopsy was obtained. This is due to laws which have now been on the statute books long enough for the profession to know their ill effects, and it is time that some concerted efforts should be made to change them.

*Stated Meeting held March 14, 1917*

The President, DR CHARLES N DOWD, in the Chair

#### PARTIAL RESECTION OF STOMACH AND ADHERENT INVOLVED PORTION OF LIVER FOR CARCINOMA

DR JOHN DOUGLAS presented a man, age forty-four, who was admitted to St Luke's Hospital August 16, 1916. He had suffered from indigestion for three or four months previous to admission. Occasion-

## RESECTION OF PELVIC COLON FOR CARCINOMA

ally vomited, and when vomiting occurred, which was only three or four times in the past three months, it was about two hours after eating, contained food eaten, was sour, and contained no blood or coffee-ground material. No blood per rectum. No tarry stools. Patient never had any pain in the stomach and is quite certain he had no gastric symptoms previous to present illness. Had lost eighteen pounds in weight. Physical examination revealed an easily palpable hard mass in the epigastrium, and radiographic examination showed a filling defect in the lesser curvature near the pylorus with a twenty-four hour gastric residue.

At operation a carcinoma of the lesser curvature near the pylorus was found. It was adhered to the pancreas posteriorly and to the left lobe of the liver anteriorly. A resection of the stomach by the Billroth No. 2 method was performed together with the removal of a wedge-shaped portion of the liver which was left adherent to the tumor.

Patient left the hospital three weeks later, after an uneventful recovery—and at present feels as strong as ever and has gained twenty-seven pounds and can eat anything.

The points of interest in this case were the short history of only three or four months before a tumor was easily palpable and the removal of the portion of the liver which microscopical examination showed to be involved by carcinoma cells by direct extension from the growth in the stomach.

The examination of the specimen of the stomach removed also showed the presence of an adenomatous polyp on the stomach mucosa 3 or 4 cm. from the edge of the carcinoma.

## RESECTION OF PELVIC COLON FOR CARCINOMA

DR. DOUGLAS presented also a man, aged seventy-one years, who was admitted to the medical ward of St. Luke's Hospital August 26, 1916. He had complained of recurrent attacks of alternating constipation and diarrhoea for three years, during which time he had lost thirty-five pounds in weight. He also suffered from prolapse of the rectum, which caused bleeding, pain, and tenesmus. Had noticed a pulsation in the abdomen just above and to the left of the umbilicus since 1910.

Radiographic examination showed a retention of a large portion of the bismuth meal in the colon for seven days, even after enemata had been given to remove it.

Operation revealed an annular carcinoma of the fore portion of the rectum about 2 inches above the peritoneal reflection of the bladder, with an enlarged gland in the mesorectum. The intestine was resected over a distance of 2 inches below and 4 inches above the tumor, and an end-to-end anastomosis done over a large tube which was sutured to the upper segment. Patient made an uneventful recovery, with no fecal fistula or leakage at the anastomosis developing, and incidentally is cured of his prolapse. Pathological examination showed adenocarcinoma.

## SUBACROMIAL BURSITIS

DR DOUGLAS presented a man, aged thirty-nine years, who was admitted to St Luke's Hospital medical wards June 29, 1916. He complained of pain in the left shoulder, which had been present for two years, during which time it had been treated by massage and local and medicinal treatment, with little relief. During the past three years he has been receiving vigorous antispecific treatment with injections of salvarsan and mercury.

A few days before admission he had received an intravenous injection of salvarsan in the left arm, after which the left shoulder became so painful that he could not sleep or rest. Abduction, rotation, and all motions of the shoulder were extremely painful. X-ray examination demonstrated a large shadow under the left acromion.

He was treated by the abduction method for six days without improvement, whereupon operation was performed.

The operation revealed a large, distended, thickened subacromion bursa containing about half an ounce of turbid fluid in which was floating a considerable amount of soft calcareous granular material. In the insertion of the supraspinatus tendon was the characteristic cheesy matter found in these cases. The bursa was dissected out and the cheesy material from the tendon insertion removed with a curette. The radiograph taken five months after operation shows that a small area of softened bone was removed at the same time.

At the present time, and since the operation, he is without pain, and motion in the shoulder joint is unrestricted.

This patient is shown because at a meeting of the Surgical Society one month ago one of the members stated that "subacromial bursitis" is a misnomer, and another that "it was not subdeltoid and not bursitis," and while he agreed that the lesion is probably primary in the supraspinatus tendon, this patient certainly had a distinct bursitis in addition.

DR ALEXIS V MOSCHCOWITZ said that it appeared to him that Dr Douglas presented this case with the intention to show the error of Dr Moschcowitz's statement at the previous meeting, namely, that, as a rule, cases presented as subdeltoid bursitis are neither subdeltoid nor bursitis. Judging by Dr Douglas's presentation of this case, Dr Moschcowitz is still inclined to maintain the correctness of his previous statement. As is well known, there are several bursæ in the neighborhood of the shoulder joint. One of these is called the subdeltoid bursa, another one is called the subacromial bursa, it is the latter which is erroneously supposed to be involved in the malady under discussion. As a matter of fact, it is not at all involved, or merely secondarily by its close proximity to the underlying tendon of the supraspinatus muscle, the calcareous degeneration of which is at the real bottom of the trouble.

DR DOUGLAS rejoined that there was, as he had said in the presen-

## POLYPOSIS COLONI

tation of the patient, a bursitis. There was a lesion in the supraspinatus tendon which was probably primary. But the enlarged, thickened bursa was under the deltoid and also under the acromial process. Therefore, he felt that it was subdeltoid and also subacromial and also bursitis.

## POLYPOSIS COLONI

DR. ROBERT ERDMANN presented a boy, who, when seventeen years old, was first operated upon for repeated hemorrhages from the colon. This began with diarrhoea and painful contractions, with blood in the stools and nausea at the age of ten. Bowel movements ten to fifteen per day. At the time of his first operation his weight was about 75 pounds. In September, 1915, hæmoglobin was 38 per cent preceding a transfusion which raised it to 75 per cent, but in November preceding the operation it had fallen to 45 per cent. In November, 1915, an appendicostomy was done. In January, 1916, the hæmoglobin was 40 per cent preceding his first operation, which was an ileostomy following, but somewhat modified, the method of Dr. John Young Brown, of St. Louis, described in the *Journal of Surgery, Gynecology and Obstetrics*, 1912. The entire colon was excluded absolutely by turning in the distal end of the ileum and implanting the proximal end of the ileum in the suprapubic region. Irrigation of the colon through the former appendicostomy wound was continued for a period of six months with no sign of improvement. Repeated examinations with the proctoscope revealed ulcerative areas and numerous small polyps.

In June, 1916, a colectomy with an ileosigmoidostomy was done, the entire cæcum, ascending colon, transverse and a portion of the descending colon were removed. At this time his weight was 69 pounds. March 2, 1917, his weight is 116 pounds, a gain of 47 pounds.

The excised colon was studded with sessile and pedunculated polyps, with here and there ulcerative areas.

Dr. Erdmann had seen this same condition five times recently, the patients all being under the age twenty-two. He also commented upon the little irritation of the skin in the majority of these ileostomy cases, also upon the extent to which these polyps involve the colon. In the majority of these cases the entire sigmoid and colon are involved, so that implantation is impossible or impracticable.

DR. LUCIUS W. HOTCHKISS, in this connection, reported a case of a young woman of twenty-one, where the polypoid growth extended to and protruded from the anus, and had been removed several times, and the case when it came into the hospital was so very ill, so far gone with this thing, that nothing could be done. She had a small perforation through the gut on the left side and an abscess formed in the abdominal



wall This was opened, and she got well of that, but died as the result of the extensive growth, which had probably become cancerous

This case had evidences of involvement of the entire lower bowel, and the anal portion of the growth had been operated upon several times

DR CHARLES N DOWD said we ought to qualify the statement that "skin destruction is not caused by the intestinal discharge when an artificial opening is made in the terminal ileum" In at least one case he had seen very extensive destruction of the outer layers of the skin from such discharge, so that there was a raw, granulating surface for several inches about the stoma

### CARCINOMA INVOLVING GLANS PENIS

DR ERDMANN presented a man who at the time of his operation for cancer of the penis was sixty-one years old—operation August 17, 1911 There was involvement of the inguinal glands and in addition a practically impassable stricture of the urethra Filiform dilatation to No 14 French and then amputation of the penis in the middle and proximal third, with excision of the glands in both inguinal regions, followed by infection in the inguinal wound which lasted fully three weeks Perfect repair and recovery with no recurrence

### COLLOID CARCINOMA OF THE TRANSVERSE COLON

DR. ERDMANN presented a man who, when operated upon ten years ago, was forty-three years of age Thought to be suffering from appendicitis, for which he was operated upon Three days later apparently suffered from intestinal obstruction Upon opening the abdomen, it was found that he was suffering from carcinomatous growth in the transverse colon A cæcosigmoidostomy was done, owing to the grave condition of the patient at the time, and three months later the involved portion of the colon was removed The transverse colon to the splenic flexure and a portion of the ascending colon were taken away This patient now has gained over 60 pounds in weight, with no evidence whatever of recurrence

DR ROBERT T MORRIS, commenting upon the case of amputation of the penis, said that nearly three years ago, after amputation of the penis for carcinoma, in one of his patients, there was recurrence in both inguinal regions He removed the glands and then shortly afterwards there was such diffuse infiltration that he gave the case up as hopeless Dr Hirsch thought that it would be worth while to use the X-ray, which was done, and this man now is apparently perfectly well Not that he is out of danger, but so far as can now be judged he is well That is a case in which, after recurrence was apparently hopeless, the X-ray has apparently caused the disappearance of all of the carcinoma

## HERNIA STRANGULATED BY CONGENITAL RING

### HERNIA STRANGULATED BY A CONGENITAL RING LOCATED WITHIN THE CONFINES OF THE SCROTUM

DR. ALEXIS V MOSCHCOWITZ presented a man, thirty-seven years of age, who was seen by him January 6, 1916, when the following history was obtained

Patient knows of the existence of a hernial protrusion in his left inguinal region for the past ten (10) years. With the exception of one occasion, about five (5) years ago, when it was acutely strangulated, and which was reduced by taxis, the hernia was always reducible. Three (3) days before consulting Dr. Moschcowitz the hernia suddenly grew larger and could not be reduced, but as the patient had no pain, nor nausea, nor vomiting, he did not worry about the hernia, and did nothing further beyond trying to replace the contents. He tried again to do so on the following morning, but was again unsuccessful. During all this time he wore his truss over the unreduced hernial contents. Subsequently further unsuccessful attempts to reduce the hernia were made by his trussmaker and also by several physicians.

When he presented himself to Dr. Moschcowitz for examination there was found a strangulated inguinal hernia, about the size of a large orange, which filled the left half of the scrotum. Owing to the mildness of the symptoms, it was presumed that omentum only was strangulated. Patient was urged to enter the hospital at once for operation, but for business reasons, and because he doubted the gravity of his condition, he did not enter the hospital until the following day.

Patient was operated upon directly after his admission to the hospital. At the operation it was found that after completely splitting the aponeurosis of the external oblique, as is customary, beyond the external inguinal ring, and after opening the sac, it was still impossible to reduce the omentum, which formed the sole content of the hernia. Before this could be accomplished it was necessary to split the sac further downward into the scrotum. About two (2) inches distally to the external inguinal ring there was encountered a very firm ring protruding into the sac and completely surrounding the latter. After dividing this ring there was no further trouble in lifting the omentum out of the scrotum, there was a very distinct constriction furrow to be seen upon the omentum, the distal part was of a deep purplish black color and necessitated resection, the proximal part was normal. After an uneventful convalescence, patient was discharged January 20.

Dr. Moschcowitz also stated that he had seen such rings within hernial sacs very frequently. This is, however, only the third time that he has seen such a ring to be the cause of a strangulation. Two of the cases were described by him in the Medical Record for April 20, 1901. The occurrence of such rings is very interesting from an embryological viewpoint, this matter was discussed in detail in the article above mentioned.

## ENCYSTED HERNIA OF COOPER

DR MOSCHCOWITZ presented a man, twenty-eight years of age, who had had a right inguinal hernia for six years, apparently it was strangulated on two occasions, but was relieved without operation. He entered hospital for a radical cure, and was operated upon by Dr Saltstein, the house surgeon, in the presence of Dr Moschcowitz January 26. Nothing abnormal was diagnosticated before the operation. At the operation a large sac containing a small amount of clear fluid was entered on the inner side of the spermatic cord, the testis was in the bottom of the sac, it was immediately seen also that the sac did not communicate with the peritoneal cavity. The general appearance of the parts, namely, a slight thickening at the upper part of the sac, led immediately to the diagnosis of an encysted hernia. Search was now made for the true hernial sac above the lower one, and then the operation was finished by the Andrews method.

The great characteristic of these herniæ, and what differentiates them from herniæ complicated by ordinary large hydroceles, is the dense adhesion where the two sacs join, in fact, it is utterly impossible to separate them with the ordinary methods of dissection. It certainly was so in the present instance, and in two other cases previously operated by the writer.

An encysted hernia of Cooper is that form of congenital malformation in which the processus vaginalis peritonei accompanying the descent of the testis becomes shut off only at the upper or abdominal end, the tunica vaginalis does not form, nor does the remnant of the processus vaginalis become obliterated.

## STRANGULATED HERNIA "EN W"

DR MOSCHCOWITZ presented a man, fifty-five years of age, who was admitted to his service at Mt Sinai Hospital November 16, 1916, when following history was obtained. He had had a very large scrotal hernia for twenty years, which had always been reducible, and which he attempted to retain with a truss, however, unsuccessfully. About six hours before admission, after a hasty movement, he found that his hernia suddenly became painful and that he was unable to reduce it in spite of numerous attempts. He did not vomit, although there was considerable nausea. His bowels moved once with the aid of an enema.

Patient was in collapse when seen by Dr Moschcowitz, shortly after his admission, his pulse was very poor and very rapid, face and extremities deeply cyanosed. On examination there was found a strangulated right inguinal hernia, about the size of a cocoanut. In addition, however, there was found a most interesting condition, namely, within the confines of the right iliac fossa and extending slightly into the pelvis, a very distinct sausage-shaped mass, about six inches long and three inches wide, which was tympanitic on percussion and was just as tender as

the hernia The mass should have been diagnosticated correctly, unfortunately, it was not, as Dr Moschcowitz looked upon the entire mass as a strangulated bilocular properitoneal hernia The error in diagnosis was proven only at the operation

*Immediate Operation.*—On opening the sac there were found within it two loops of small intestine, each about the size and shape of a ring sausage, of a deep purplish, almost black, color, which apparently had no connection with one another within the hernial sac When the strangulation was relieved, pulling upon the loops brought down only normal intestine, with distinct strangulation furrows A finger introduced into the abdomen now felt another loop of intestine, which, on account of its size, could not be brought out of the abdomen The hernial ring had to be split wide open before this could be accomplished It was then seen that it was a loop of intestine fully 6 inches in length and about 3 inches in width, of an absolutely black color, and very much infiltrated, it was evidently strangulated much more seriously than the scrotal loops, because whereas these recovered their circulation completely within ten minutes upon the application of warm saline, the abdominal loop did not recover for a full half hour The loop was then returned, and the operation was finished by the Andrews method Slight infection of the wound followed, but patient was discharged sixteen days later Much to Dr Moschcowitz's surprise, the patient has a small recurrence at the lower angle

This case is typical of that form of strangulation which has received the name of "hernie en W" Dr Moschcowitz believes that in this instance it was brought about by partially successful attempts at taxis, which reduced the smaller connecting loop into the abdomen and left 2 loops in the scrotum The difference in the appearance of the 3 loops was particularly well marked and can be accounted for by the fact that the loop was strangulated not only by the hernial ring, but also that its mesentery was bent upon itself very sharply at an acute angle

#### TRUE PERINEAL HERNIA

DR MOSHCOWITZ presented a girl two and a half years of age Six or seven weeks before, the mother noticed quite accidentally a swelling in the right buttock, this swelling increased greatly in size during the following four weeks, but apparently it caused no discomfort to the patient

The general physical examination was negative except for the following There was a moderately firm, very movable swelling in the right buttock, occupying, roughly speaking, the region bounded mesially by the coccyx and anus and laterally by the tuber ischii and gluteus maximus The palpable surface of the mass was globular, and increased in size when the child cried On manipulation this mass escaped in an upward direction, but it never disappeared entirely The tumor caused

a notable fullness in the buttock, unfortunately, however, the photographs made did not turn out sufficiently well for reproduction. On palpation per rectum there is to be felt a mass upon its right, when an attempt was made to reduce the mass the finger in the rectum felt that the fullness increased. It was impossible to determine by examination whether the hernia (for such it was taken to be) was reduced through the sciatic notch or through a hiatus in the levator ani.

Dr Moschcowitz was somewhat at a loss to account for the fact that the hernia could not be reduced completely no matter what the manipulations, or how frequently attempted. Finally the conclusion was arrived at that there existed a peritoneal lipoma in connection with the hernia, or that the contents were adherent to the fundus of the sac. As will be seen, the former diagnosis proved to be correct.

Two methods of procedure were considered, namely, either by the abdominal or by the perineal route. On account of the large subperitoneal lipoma, the final decision was made in favor of the former. The operation was performed May 23, and the procedure was as follows.

With the patient in the prone position, and with the buttock elevated, an oblique incision about 3 inches in length was carried over the tumor in the right buttock. On reaching the ischio-rectal fossa there was encountered a long lipomatous mass, distinctly encapsulated, leading upwards and into the depth. At its basal attachment, where it was distinctly more adherent, it had to be separated from the underlying peritoneum by sharp dissection. When this was accomplished there was found a defect in the pelvic floor, through which 2 fingers could be introduced into the abdomen as high as the pelvic brim, the finger entered through the posterior part of the levator ani, approximately just anterior to the coccygeus, on increasing the intra-abdominal pressure a hernial sac was seen to descend through this hiatus, this sac, however, was not opened nor resected, as it was seen to be too intimately adherent posteriorly to the rectum, and anteriorly to the vagina (hernia par glissement). The opening in the depth of the pelvic floor was then closed by interrupted chromicized catgut sutures, and was then reinforced by liberating the gluteus maximus and suturing its inferior margin to the deep pelvic fascia.

The specimen removed proved to be a lipomatous mass 6 inches long and 2 inches wide. A small portion of peritoneal sac was adherent at its deepest attachment, and was proven to be such on microscopic examination.

After primary union of the wound, patient was discharged June 9, 1916.

From as much information as could be gained from the operation, it appeared to Dr Moschcowitz that the hernia made its exit at the seat of predilection for these herniæ, namely, at the posterior border of the levator ani, or, better said, through the very frequent cleft between

## THE SPRENGEL TRANSVERSE ABDOMINAL INCISION

the levator ani and coccygeus; and that subsequently the hernia burrowed a way for itself into the ischiorectal fossa. In this respect it corresponds to the picture of the few other cases of classical perineal hernia reported. The lipoma which accompanied the hernia is not at all an infrequent occurrence.

DR GEORGE D STEWART had been disposed to consider that strangulation, or constriction which may result in strangulation, may occur at the inner ring, through the canal, at the outer ring or anywhere beyond that in the sac. Frequently a sac almost closes at the ring, and then another portion of the peritoneum is pushed down and the first constriction depressed beyond the level of the external ring remains as a constriction in the sac. This process may be repeated several times, so that often, particularly in the congenital hernia, one may find the remains of several rings in a hernial sac. He recalled distinctly having seen strangulations occur in one of these old narrowings, so that Dr Moschcowitz's location of the possible strangulation is not, he thought, correct.

DR MOSCHCOWITZ said that the constriction described was outside of, but still part of, the sac. In other words, after the sac was peeled away there was a constricting ring composed of a mass of fibrous tissue, which elevated the serosa all around.

## THE SPRENGEL TRANSVERSE ABDOMINAL INCISION

DR ARTHUR S VOSBURGH presented two patients illustrating the use of the Sprengel incision. He said that his interest in this particular incision arose from two unfortunate results which came under his immediate observation recently. Previous to seeing the failures in these two cases, his acquaintance with and knowledge of the incision was purely academic.

The first patient was a strong, vigorous man, upon whom he had done an exploratory celiotomy for suspected gastric ulcer, using a right rectus vertical incision. The patient took ether very badly, straining and vomiting during the entire time of anæsthesia. His convalescence was stormy, marked by the inability to take fluids or hold anything on his stomach. This occurred without temperature or increase in pulse rate. He had no movement of the bowels, and began to look pinched. On the fourth day it was evident that the man was suffering from an ileus undoubtedly mechanical in its nature. The patient was taken to the operating room, and, with Dr Darrach's assistance, the abdomen was reopened through the old incision. On dividing the suture line, a loop of intestine 15 cm in length lay in the long axis of the wound between the fibres of the rectus muscle. This was dark, had lost some of its lustre, and was coated here and there with flakes and fibrin. This was freed, washed off with hot solution, placed in hot saline packs, and, as circulation was not impaired and color returned to the loop, it was

dropped back into the abdomen. An investigation of the deeper portion of the wound revealed the fact that the peritoneum, together with the posterior aponeurosis of the transversalis (which in this portion of the abdomen are intimately adherent), had retracted to a distance of from 2 to 3 cm. on either side of the line of the incision. This man died.

Another case presenting a similar condition had a more fortunate outcome. This second case had sustained a stab wound of the abdomen, dividing the deep epigastric artery. His abdomen had been explored through a separate incision and the bleeding points secured. No further lesion having been found, the patient's wounds were closed in the usual manner. The incision was a vertical one through the right rectus extending 4 cm. above the umbilicus to 8 or 10 below the umbilicus. A day or two following his operation the patient called the attention of his doctor to his wound, saying it felt "wet," and he thought something "had given way." When the dressings were removed it was discovered that the patient had torn asunder the suture line and partially eviscerated himself. A loop of small intestine lying in the long axis of the wound was very much in the same position as in the case previously described. Here the result was more fortunate. After washing the loop of intestine it was pushed back and the wound was drawn together with adhesive straps. The patient made a slow recovery, the wound healing by granulation.

Consideration and study of these two cases convinced him that any operation upon the upper abdomen, where, because of distention, or by reason of conditions which would throw the transversalis muscle of the abdomen into active contraction, calls for the selection of incisions other than the vertical ones.

Dr. Vosburgh here presented his first case in which he had used the Sprengel incision.

A man had sustained a stab wound, self-inflicted, of the left upper quadrant. The wound was made with a butcher's knife an inch in width and 6 or 8 inches in length. The direction of the blade had apparently been backward and downward. The knife had divided the seventh costal cartilage on the left side, entering the anterior extremity of the costophrenic sinus. The situation of the wound and the symptoms of rigidity in the left upper abdomen called for immediate celiotomy. There was no enlargement of the precordial area of dullness, no sign of hæmothorax or pneumothorax. The abdomen was opened by a transverse incision placed about 5 to 7 cm. above the level of the umbilicus, extending from the median line across the rectus well into the oblique muscles on the left side of the abdomen. This incision gave an excellent exposure of the upper abdomen. The control of the rectus was accomplished by placing 2 or 3 catgut sutures (passed on a curved needle by the sense of touch through the substance of the rectus above and below the intended line of incision). The exploration of the abdo-

men disclosed a wound on the anterior surface of the stomach, 3 cm below the lesser curvature, a little to the left of its mid point, a punctured wound through the left lobe of the liver, and an opening in the diaphragm a little to the left of the central tendon. The incision gave ample room for the closure of the wound in the stomach and for the suture of the diaphragm. The wound through the liver had ceased to bleed, and this was left alone.

It will be seen from the description that the intra-abdominal work was carried on in a region ordinarily difficult of approach, yet so good was the exposure obtained by the incision that the work was accomplished with the greatest ease. This patient had an uninterrupted convalescence except from a chronic gut abscess discovered on the eighth or ninth day. This was in the left extremity of the wound, not over the region of the divided rectus.

The second patient on whom he used this incision gave a history of chronic appendicitis, the symptoms being ascribed to the presence of adhesions about this portion of the intestines, *i e*, cramp-like pains, referred to the middle region of the abdomen. A transverse incision was made dividing the right rectus, extending from the midline into the oblique muscles on the right side above the level of the semilunar fold of Douglas. A fan-shaped adhesion bound down the distal third of the appendix, the spread-out portion of the fan being attached to the right iliac fossa. This adhesion, together with the mesentery of the appendix, so included the terminal ileum that inversion was inadvisable.

He presented these two cases to illustrate the value of the Sprengel incision. Although his experience in its use had been so limited, the mechanics of the incision appealed to him very forcibly. The physiological action of the abdominal muscles has been so ably presented by Dr Moschcowitz that he did not think it necessary to discuss it. The incision is, of course, applicable to those portions of the abdomen where the peritoneum is intimately adherent to the transversalis muscle or its aponeurosis. Thus, in the lower abdomen, where the aponeurosis of the transversalis passes anterior to the sheath of the rectus, it has no advantage over other incisions, but where the aponeurosis of the transversalis muscle passes posterior to the sheath of the rectus it has its greatest value. The direction of the pull of the combined forces of the oblique muscles of the abdomen is transverse in direction. Dr. Moschcowitz has well pointed out that the aponeuroses of insertion should be considered as minute tendons running transversely to their insertion in the linea alba. Therefore, sutures used to unite a vertical incision lie between the strands of these small tendons, and when the transversalis is thrown into action these sutures tend to pull out with greatest ease. For example, if an attempt was made to unite two whisk brooms end to end by interrupted sutures passed between the individual strands



from one broom to the other, the futility of the effort to so unite the brooms would be apparent

The objections to the incision may be grouped under the following heads

1 Time in getting into the abdomen In his cases it was but little longer than it takes to make an ordinary vertical incision

2 Division of the rectus A study of the nerve supply of these muscles shows that they are less liable to be injured in this incision than in a vertical incision

3 Closure of the abdomen is much more rapid in a Sprengel incision than it is in a vertical incision, where the patient is strangling and straining under a difficult anæsthesia or because of irritating causes of operative procedure

4 Drainage can be introduced as well in this as in the vertical incision, selecting that portion of the incision not traversed by the rectus muscle

Dr Vosburgh presented a third case, a man thirty-five years of age, who was admitted to Bellevue Hospital January 9, 1917 As the patient spoke no English, a complete history could not at first be obtained The patient was in shock, with pain and rigidity of the right upper abdomen, a weak rapid pulse, a high blood count, the history of vomiting, and the extreme agony which the patient was enduring demanded an immediate celiotomy The abdomen was opened by a vertical incision through the upper part of the right rectus muscle The abdomen was full of bile-stained fluid The injection of the peritoneum was more marked as the pyloric region was approached A perforation was discovered in the centre of an indurated area, situated in the anterior wall of the first portion of the duodenum The perforation was closed by two sutures of plain catgut placed as purse-strings about the opening As the walls of the intestines were so indurated as not to allow perfect tying of the purse-string sutures, it was deemed best to drain A rubber dam drain was placed in the middle of the incision and withdrawn the following day His convalescence was unmarked by pain, vomiting, or rise in temperature A profuse discharge continued from the site of the drain for upwards of a week This led to the belief that the occlusion of the perforation in the bowel had not been perfect

The peculiar fact (elicited from the patient's brother, acting as interpreter) was the absence of pain at any stage of gastric digestion The ulcer must have been of long standing, at least of sufficient length to account for the marked induration found in the wall of the gut

DR CLARENCE MCWILLIAMS said that eight or ten years ago he saw Roux, in Lausanne, Switzerland, make this transverse incision, and he did it as though it were an every-day occurrence to him, and he said that he used it in all his upper gastric cases exactly as it is done to-day

Personally, in the long run, Dr McWilliams did not believe that this

transverse incision will prove to have greater advantages than the vertical one. There will be just as many herniæ following it as with the vertical incision. The repair of such a hernia will be more difficult than that following a vertical incision. If one makes the vertical incision long enough one can get almost as good an exposure with it as with the transverse incision.

DR. N W GREEN said that Dr Abbe presented a young woman before this Society in April, 1912, who was at that time about twenty-two years old, and upon whom he had operated when an infant. He had used a transverse incision just about the level of the umbilicus for the removal of a kidney tumor. He augmented this incision by an additional median line incision, and he spoke at that time of the facility with which he was enabled to take it out. He said the tumor weighed a third of the weight of the child before operation, or when removed the child weighed 15 pounds and the tumor  $7\frac{1}{2}$  pounds. That was twenty years before he presented the case, and it would be now about twenty-five years ago.

He had been interested in this incision, and he thought that in certain cases, if one makes the selection of the case, it is far superior to the longitudinal rectus incision. But there is a certain type of cases where one cannot get as much access to the dome of the abdomen as by the longitudinal rectus incision, if one will bring the upper part of the incision toward the median line, especially in those patients that are very thick through the chest and are inclined to barrel-shaped chests. In these the cross incision does not give as much access to the gall-bladder region as does the longitudinal rectus incision.

He was fortunate enough to have a couple of acute gall bladder cases on the same night a little while ago, and in one he used the transverse incision and in the other he used the regular right rectus incision in order that he might see which one gave the easiest access. He thought the regular right rectus incision gave him a little easier access than the transverse incision in that particular case, but the transverse incision was far easier to sew up.

DR. EUGENE D. STEWART said that many had used the transverse incision accidentally or incidentally, but to deliberately place the transverse as the operating incision, not as an addition, has not been done for a long time or consistently. Moschcowitz taught the deliberate placing of the transverse incision and he proposed to call it by his name. He employed it at his clinic last Saturday. The first case was diagnosed gall-stones most definitely by the X-ray. The case turned out to be a tumor of the suprarenal body. Having started with a vertical incision, he added a transverse one, and succeeded in making a very comfortable exposure.

In the next case the X-ray said most decidedly that there were no gall-stones and no pathological condition of the gall bladder. Patient

had been operated on seven months before at another hospital, a number of stones had been taken out, a cholecystostomy performed, and the biliary fistula had persisted, closing only a few days before his operation. The opening of the fistula was some distance below the ribs. The edge of the liver could be felt practically two to two and one-half inches above that level. He employed a Moschcowitz-Sprengel incision, exposed the edge of the liver, then, working downwards, removed the adhesions and got a satisfactory exposure for removal of the gall bladder. Incidentally, the X-ray notwithstanding, the gall bladder was pathological and there was a gall-stone.

He had used this incision on a good many other occasions. It has many advantages, but one cannot say that it is universally applicable. In the lower abdomen it is rarely of service and not always to be employed in the upper by any means. He was guided in its employment by the exposure he was seeking. If he wanted to see a good deal of the abdomen transversely he used the transverse incision, if it is the vertical exposure he was seeking, he used the vertical. A vertical exposure is much more frequently to be employed than the transverse.

DR WILLIAM DARRACH reported one transverse incision that he did last August for a man that came in with a large hernia following a kidney incision in the loin and also symptoms of incomplete obstruction.

They cured his lumbar hernia and did a transverse incision and found a chronic gall bladder, an angulated transverse colon. They took out the gall bladder and freed these incisions through a Sprengel incision. This resulted in moving his hernia over from the left to the middle line. He has a hernia now allowing a distinct bulge in the region of the right rectus, although the anchoring sutures of chromic gut were used and they thought they did a careful suture afterwards.

One other interesting point about the man was that in closing his hernia in the loin some twenty-day chromic gut was used, which gave him a severe neuralgia of the ileohypogastric, which lasted for forty-one days and then stopped rather abruptly.

DR ALEXIS V MOSCHCOWITZ said that in a measure he is discussing the transverse incision, so to say, *in loco parentis*, and therefore he hates to disagree with some of the beautiful things that have been said about the incision. He had found the incision to work beautifully for 135 cases, but the 136th case developed a hernia, which was about as bad a hernia to close as any one in his experience. The next four cases were again perfectly normal, but the following case ruptured his wound open on the sixth day, he was resutured, and again ruptured his wound open after another seven days. This wound has healed by granulation, and Dr Moschcowitz has no doubt it will also be followed by a hernia.

Accidents of a similar nature are more frequent after longitudinal incisions. In spite of these two accidents, Dr Moschcowitz still be-

believes that the incision is anatomically correct, and he will continue to use it

## POST-OPERATIVE BURSTING OF SUTURED ABDOMINAL WOUNDS

DR WILLIAM DARRACH said that the question of bursting out of the deep line of sutures is one that had interested the surgeons at Bellevue recently rather seriously. He would like to find out how frequently such an accident does happen. It hadn't happened to him until a little over a year ago, and since then he had had two cases, and there had been two others on the First Division, where the deep layers had given way and there had been a prolapse of intestine with no separation of the skin edges.

DR ALFRED S. TAYLOR said that he had been so unhappy as to have had three ruptures following transverse incision. It had seemed to him, however, that the exposure and the working facilities are so much better with a transverse incision for the pyloric region and the gall bladder region as to make it worth the chance.

Some of the hernias have been due to wound infection. Unfortunately, perhaps they had had an unfair proportion of wound infections at Fordham, and three or four ruptures had occurred there. The fourth one occurred in a hospital which usually gives perfectly good results so far as asepsis is concerned. Just why the infection occurred there, one is not able to explain, but the rupture didn't occur until some ten or twelve weeks after the wound had healed solidly. When the patient left the hospital the wound was perfectly solid in every way and he thought there would be no difficulty whatever, but after some ten or twelve weeks he was called up and told that there was a large protrusion of the skin just above the scar, the rectus in that case had apparently separated through its entire width, a distance of two and a half inches.

DR WINFIELD S. SCHLEY said that he was rather surprised that the silk or the silkworm retention suture is not used oftener. It is rather unsightly and it leaves telegraph pole marks on the skin if drawn too tight, but there are a goodly number of cases, such as in carcinoma and where poor repair is to be expected, where it can especially be used to advantage—put through the skin, through the fascia, with or without including muscle, brought out and tied after the layer sutures are in, and cut out at the end of ten or twelve days. He did not remember to have had a single wound pull apart under such circumstances. It is rather a nuisance, and patients at the present day don't like having sutures removed, but it saves many wounds from opening up, used in this way, as an addition to the regular layer suture.

It is largely a question also of technic, sutures should not be too tight or cutting results, with pain and scarring. They should be tied only tight enough to barely approximate the skin, or not even that where the abdominal wall is thick, as wound swelling always tightens them more.

DR BURTON J LEE said the only case he could remember having had break open in the last two years was one in which silkworm gut was used. He practically had given up the use of silkworm gut. It seemed to him that silkworm gut does not hold, but cuts whatever it is put into. The difficulty with most deep sutures is that the materials are often defective. Without mentioning any manufacturers' names, he had the feeling that a good deal of gut is put out that is defective in tensile strength.

DR HERMAN FISCHER said that for the last four years he had made the transverse abdominal incision a routine incision for his upper abdominal work, especially in gall-bladder work and in perforation of the duodenum or stomach near pylorus. He always added a median incision, since it gives such a very excellent exposure to all the sutures beneath. He had used the longitudinal rectus incision for a long time until he came across a few cases, especially in elderly and very fat women, in which there was a very extensive atrophy of the whole rectus muscle with a very large bulging of the upper part of the abdomen, a condition that gave those women quite some distress.

As far as the breaking open of wounds is concerned, he thought that it has happened to him as to everybody else. The break usually occurs between the seventh and tenth days. For six or seven years he had used very heavy through-and-through silk sutures in addition to a careful layer suture in all his upper abdomen work in midline incisions, especially in men in whom gastro-enterostomy had been performed or resection of the stomach, men of very lean and very emaciated physique, in whom the power of repair of the tissues is below par. There is no infection, but the cut tissue simply does not heal together. He was very well satisfied with this combined suture.

DR PARKER SYMS said that he had no experience to speak of with the transverse incision. As to the proper manner of suturing the abdominal wall, he thought deep sutures should always be employed. This is not only for the purpose of preventing gaping of the wound and evisceration, but, what is of equal importance, to make the wall homogeneous and to avoid pocketing and the escape of blood into pockets of the wound. Of course if a wound is sewed in layers it is sewed into sections and pockets. By incorporating the entire thickness of the wall by these deep sutures that possibility is avoided.

If this is done he thought incidentally a certain number of pulmonary emboli would be avoided.

DR ALFRED S TAYLOR reported a case in which the longitudinal incision of the rectus had been used and was apparently healed perfectly well. The sutures had been removed on the sixth day with a very good primary union. On the twelfth day the wound split open without any effort on the part of the patient, no coughing, no strain of any kind, no vomiting. No attempt at healing had ever taken place during the twelve days.

## TREATMENT OF ERYSIPELAS

It looked just like the wound that one makes in a cadaver and leaves for a time and then goes back and looks at it. They put his intestines back and made the best suture they could. He wasn't in very good shape and they didn't give him an anæsthetic. After they got him back to bed Dr Rogers came in and he drew out of his pocket a little bottle of thyroid residue and said, "Give him some of that," which they did. The wound healed solidly that time. It seemed to stimulate his healing capacity.

DR. CHARLES N DOWD added a word for the use of silkworm gut. For several years he had used it in the routine closure of abdominal wounds, placing the stitches through the skin and fascia and reversing the direction of the fascial part of the stitches, figure-of-8 fashion. The wound edges had held remarkably well, and it has seldom been necessary to use chromic gut. He avoided chromic gut on account of its uncertain absorbability.

## TREATMENT OF ERYSIPELAS

DR. SEYMOUR M. MILLIKEN read a paper on the above subject, for which see page 129.

DR. ALEXIS V MOSCHCOWITZ asked whether erysipelas cases are isolated at Bellevue Hospital, and, if they are, why they are isolated. At Mt Sinai Hospital erysipelas patients are not isolated, they are kept in a separate room adjoining the general surgical wards, so to speak, under erysipelas precautions, which really do not amount to very much. Dr Moschcowitz does not recollect having seen a single case of secondary infection.

DR. JOHN F ERDMANN said that for the last two years in his service at Bellevue Hospital they did not transfer them immediately. They are perfectly willing to keep them alongside of the next patient, but prefer that they are removed. In so far as patients have gone, we have not had one single contamination. In a case not long ago there was absolutely no attempt on the part of the institution to produce any isolation, the nurses intermingled, and there was absolutely no contamination. He did not believe that it was necessary to isolate erysipelas patients.

DR. ARTHUR S VOSBURGH said that he had had charge of a Bellevue service in the summer for quite a number of years, and when in charge he was often on duty in the wards, and after making his rounds in the erysipelas wards he always went up and finished his operating, and did not know of a single case that contracted erysipelas from the fact that he was on duty in both services.

DR. CHARLES N DOWD said that he had been attending surgeon in at least one of the hospitals that had been mentioned, and he remembered a case of erysipelas which occurred in the ward and was moved into a little room off the ward, and much more careful precautions taken than apparently are taken in these cases that had been spoken of.

However, two or three patients in the hospital contracted the dis-

ease, as did one of the nurses, who was very ill and also suffered most severely from the constitutional effects of the inflammation. Hence after that experience they were very careful where the erysipelas cases were put. If they go into a little room off the ward, or in a single room anywhere, they insist they have precautions which are fairly strict—that is, nurses and doctors who take care of them use gloves and gowns and do not come into contact with other patients until a careful cleansing has supervened.

DR JOHN DOUGLAS was in charge of the erysipelas wards in Bellevue for several years some years ago, and he never saw a case of erysipelas developed in those wards, although they had during that time a considerable number of cases sent into the ward with a diagnosis of erysipelas that had cellulitis or some other condition.

In his first year of service in the erysipelas ward an attempt was made by one of the other surgeons to give a patient erysipelas, who had had an inoperable sarcoma. He was vaccinated, scratched, and serum inoculated from another patient's blebs, but it was absolutely impossible to develop erysipelas in this man.

At the same time in another hospital, where every precaution was taken, he remembered very distinctly a case of a patient developing erysipelas, who was removed at once and every precaution taken to isolate him, but the next patient who went into that corner of the ward developed erysipelas.

DR RANSOM S HOOKER thought most of the surgeons connected with Bellevue Hospital felt that with ordinary caution there is very little chance of spreading erysipelas, however, a very curious coincidence happened about a year ago. While they were still in the old buildings they moved the erysipelas patients to a ward which was beyond the men's surgical, the only entrance to which was through this surgical ward. During the few months it was there three cases of erysipelas broke out in this surgical ward in postoperative cases, which, to the best of his memory, had not happened before, at least in the past ten years.

DR SETH M MILLIKEN said that erysipelas is isolated at Bellevue because it is the dumping-ground of the other hospitals' erysipelas cases. Also, there is a city rule that erysipelas must not be treated in the general ward, but must be sent to a special division.

As to infection occurring in erysipelas wards, there was one nurse infected in that ward in the last four years. That was a male nurse who had a severe cold at the time and got erysipelas in the nose, which spread over his face. When the erysipelas was in the old building the cases of measles, for temporary isolation, before being taken by the Board of Health, were kept in that same ward—children who had whooping cough were kept in that same building, just around the corner, and in none of those patients did erysipelas develop.

## SEPTIC INFECTION OF KIDNEY AFTER INFECTION OF FINGER

Three years ago in Lincoln Hospital he treated three cases of erysipelas in the general surgical ward. They were not sent to isolation at all and no other cases of erysipelas developed.

*Stated Meeting held March 28, 1917*

The President, DR CHARLES N DOWD, in the Chair

### UPWARD DISLOCATION OF THE TARSAL SCAPHOID

DR HOWARD D COLLINS presented a man, thirty-nine years of age, who on the 12th of February last stepped on a round piece of wood, stepping with the front part of his foot, and his foot turned under him, with the result that he received a dislocation upward of the tarsal scaphoid together with a fracture of its inferior and posterior lip.

Two unsuccessful attempts were made, one without an anæsthetic, and one with, to reduce this dislocation. Then under anæsthetic Dr Collins made a curved incision on the inner side of the foot and succeeded with the periosteal elevator in prying the bone back in place. When reduced a plaster bandage was applied and has now been worn for five weeks, and he can get around on his feet fairly well.

### OBSTRUCTION OF THE COMMON DUCT CHOLECYSTECTOMY

DR COLLINS presented also a man on whom he had operated two years before for gall-stones, which he removed without the removal of the gall bladder itself. The patient remained well two years, when he was operated upon for double inguinal hernia. Four days after this operation, while in bed, he was seized with very violent pain in the abdomen, referred to the region of the old gall bladder operation. On the following day the doctor cut out the old scar and found evidences of fresh separation of the rectus muscle. The wound was sutured, but four days later there was a renewal of very violent pain in the abdomen. Examination showed a dense, tense globular mass about one inch in diameter, which felt as if there was a hernia forming in the site of the gall bladder incision. The incision was re-opened and revealed a very greatly distended gall bladder pressing up against the abdominal wall, but the suture line in the abdominal wall was perfectly intact. One gall-stone was found in the neck of the gall bladder, which had caused the trouble. Dr Collins then removed the gall bladder with its contained stone, and the patient has made a practically uneventful recovery.

## SEPTIC INFECTION OF KIDNEY AFTER INFECTION OF FINGER

DR HERMAN FISCHER presented a man, twenty-four years of age, who had been ill for about three weeks with an infection of his left index finger which was incised. After some time he developed severe pain



in his right side with high temperatures. Slowly a swelling in his right lumbar and hypochondriac region developed that reached nearly to the umbilicus and down towards the anterior superior spine of the ilium. The swelling was tense and extremely painful. Patient had the appearance of a very sick man. Temperature  $103.8^{\circ}$ , pulse 140. Blood examination showed 20,400 leucocytes with 85 per cent polynuclear cells, 4 per cent large lymph and 11 per cent small lymph. Urine examination, acid, clear amber, trace of albumen, a few pus-cells, and an occasional granular cast. *Diagnosis*, Perinephritic abscess.

November 7, 1917, an incision into the perinephritic region was done, and a large quantity of thick creamy pus evacuated. As the patient's condition was very poor, the kidney was not explored. The abscess cavity was drained.

On the first day after the operation the temperature dropped to normal, but quickly rose again to  $102^{\circ}$  in the morning and  $103^{\circ}$  in the afternoon. The abscess cavity had cleaned up almost entirely in about ten days, and there was hardly any secretion from the wound. In spite of this the temperature kept up. It was now clear that the kidney must harbor an infectious focus, as no other cause for the high temperature could be found. Three weeks after the first operation an exploration of the kidney was decided upon. On enlarging the wound the kidney was found quite tightly embedded in the remnants of the fatty capsule, which was quite infiltrated and firmly adherent to the kidney. The kidney was enucleated and removed. On inspecting the specimen it showed that the interior half of the upper pole of the kidney had become necrotic and completely sequestered. In the pus of the sequester staphylococcus aureus was found. After the nephrectomy the temperature came down quickly to normal, and the patient made an uneventful recovery.

#### UNILATERAL SEPTIC INFECTION OF KIDNEY

DR FISCHER presented also a young woman, twenty-five years of age, who was operated upon four years ago for an appendicitis abscess. Four months ago she was suddenly taken ill with severe pains in her right hypochondrium, radiating into the back. She was nauseated and vomited frequently and copiously. She also had fever. She was confined to bed for one and a half weeks. She recuperated from this attack and felt fairly well until one week before she entered the hospital. At that time she again had an attack similar to the previous one, except the pain in her right side was much more severe and she felt much sicker. When admitted, the right side of her abdomen was held rigid, there was marked tenderness over the lumbar and iliac regions. A large, tender mass could be felt in the right lumbar region, fairly well outlined and not movable. It extended downwards one and one-half inches below umbilicus and disappeared upward under the ribs. Bimanually

the mass was easily palpable and appeared to belong to the kidney  
Temperature 103.8°

Cystoscopic examination and catheterization of ureters showed the bladder mucosa to be slightly injected Ureter openings normal Urine from right side Acid, spec. gr 1015, clear Trace of albumen, many pus-cells, some red blood-cells, occasionally hyaline cast Urine from left side Acid, spec. gr 1015, clear, trace of albumen, a few leucocytes Functional test, normal for both kidneys

Under a diagnosis of septic infection of right kidney, nephrectomy was done The kidney was found considerably enlarged, measuring 12 cm from pole to pole, about 7 cm transversely, about 3 cm antero-posteriorly The capsule was easily stripped from the organ, leaving a pale yellowish-brown surface marked profusely by yellowish, raised areas ovoid or circular in form, measuring about 6 mm in diameter These elevations were soft and surrounded by a narrow zone of congestion The smaller ones were crowded together near one pole and the largest, measuring about 2 cm in diameter, situated along the convex margin On section these raised areas on the surface are seen to correspond with wedge-shaped areas penetrating the entire thickness of the secreting parenchyma, where the renal tissue is soft, pultaceous, and necrotic Smears from these areas show innumerable polymorphonuclear leucocytes, but no very definite microorganisms The calyces are not dilated and the mucosa of the calyces and pelvis does not appear thickened or inflamed Here and there are small petechiæ The kidney parenchyma between the infarcts is pale and slightly swollen, shows no very marked alteration The larger vessels of the hilus contain no visible thrombi

Microscopical examination of section passing through one of the wedge-shaped areas noted in the gross specimen shows in this region the renal tissue to be diffusely infiltrated by polymorphonuclear leucocytes so densely the original renal elements are practically entirely obscured Here and there the remainder of tubules can be found, the lumens of which are crowded with pus-cells, and also here and there a few glomeruli Necrosis and liquefaction, on the other hand, is comparatively slight, although the centres of a few of the larger areas appear to be undergoing commencing liquefaction The margins of these infected areas are fairly sharply marked off The adjacent renal epithelium, however, appears degenerated and similarly necrotic Rather hemorrhagic areas are noted In the section examined no definite thrombus was noted in any of the areas, but the distribution and shape of the infected areas leave the hæmatogenous origin beyond a doubt

Cultures from the kidney show in pure culture a dextrose fermenting Gram negative bacillus which fails to ferment lactose promptly, *i.e.*, one of the intermediate typhocolon group

DR EDWIN BEER believed, as the result of a number of articles written in recent years, that a great many kidneys have been sacrificed unnec-

essarily It is generally considered that hæmatogenous infected kidneys should be nephrectomized A protest is timely against doing regularly nephrectomy in these cases There are two very distinct types of case—one case associated with pyuria and colon bacillus, and the other without pyuria, usually with a few red blood-cells and usually due to staphylococcus aureus Almost invariably one can get along without a nephrectomy in the colon pyelonephritides, decapsulation or nephrectomy meeting the indications in even severest cases, while no operation may be necessary in milder cases unless there is a stone in the kidney (and if there is a stone there it should be removed), while the second group of cases will very frequently have to be nephrectomized, though resection may at times be satisfactory

In one of these cases Dr Fischer had shown there was a colon infection, or colon group infection That type of case can almost regularly be cured without losing the kidney As far as the carbuncles are concerned, the staphylococcus aureus infarctions leading to multiple abscesses are less common

#### CONSERVATIVE AMPUTATION THROUGH THE UPPER THIGH— DISINFECTION OF THE STUMP BY THE CARREL METHOD

DR H H M LYLE presented a boy who, ten years ago, sustained an injury to the knee which resulted in an infected arthritis and an osteomyelitis of the femur Six extensive operations have been performed and several minor ones In spite of this treatment the condition has grown steadily worse The condition of the femur is shown in the accompanying radiograph (Fig 1) There are 7 actively discharging sinuses, two of these are within 3 inches of the anterior superior spine

The radiograph shows that the osteomyelitic process extended up to within an inch of the great trochanter, the bone above this point appears to be healthy Knowing the unsatisfactory functional results and the difficulties of fitting a suitable artificial limb in a disarticulation, he determined to do an aperiosteal amputation, making the bone section one inch below the trochanter As the sinus tracts had to be crossed, he followed the method of open amputation and went through the infected area, this is a common practice in military surgery The stump was disinfected by the Carrel method and the flaps approximated by traction The result is very satisfactory (Fig 2) Despite the very short stump, the boy walks well and bears all his weight on the end of his stump (Fig 2) The provisional plaster peg-leg (Fig 3) was made by the head nurse It is the first one she had ever seen or made, so one sees it is not a very difficult thing to do

DR CHARLES N DOWD said that in hospital service, with frequently changing house-surgeons, it is difficult to secure artificial legs such as Dr Lyle describes The molding and fitting of the plaster requires time and a certain degree of skill A carpenter and a harness-maker,



FIG 1 —Radiograph of the right femur, showing the extensive nature of the osteomyelitis. Note the line of bone section one inch below the great trochanter



FIG 2 —Patient performing his weight-bearing exercises to prepare his stump for a temporary peg-leg



FIG 3 —Patient wearing the temporary peg-leg



## ASEPTIC AMPUTATION OF RECTUM

however, provide a very good apparatus. The former makes the peg, of suitable length and with a suitable notch at the top, and the harness-maker makes a leather cuff which encircles the thigh and makes a suitable housing for the padding on which the end of the stump rests. The procedure is thus simplified.

## VALVULAR CÆCOSTOMY FOR COLONIC ILEUS

DR EDWIN BEER presented a feeble woman of seventy-four years. Constipation developed for the first time eight days before admission, and during this period the bowels did not move adequately, though some flatus and particles were brought away by means of repeated enemata. Vomiting and extreme distention developed. No masses were palpable, and barium enema X-ray did not show the seat of obstruction, as the whole colon filled up to the ilio-cæcal valve. The distention of the cæcum was extreme, both by percussion and in the X-ray.

On December 7, 1914, under local anæsthesia, the abdomen was opened in the region of the cæcum, and, owing to the general condition of the patient, as well as to the enormous distention of the intestines, no extensive search was made for the cause of the ileus. The huge cæcum was so stretched that its serosa had ruptured in several spots, and scattered over its wall were numerous areas of what looked like suppurating foci. It was decided to evacuate this part of the bowel and do a cæcostomy of the Witzel type, infolding several layers of cæcal wall. This was readily done and the patient made a satisfactory recovery. All subsequent abdominal examinations, as well as X-ray studies, failed to show a tumor or a stricture of the colon. The bowel shortly after the operation emptied itself, after irrigation through the cæcostomy tube, by the normal channel, but that lasted only a few weeks. Since over two years all the intestinal contents are washed out every day or every other day by means of lavage through the cæcostomy tube, nothing being discharged through the rectum. All this time the patient has no trouble in keeping herself absolutely clean and odorless.

Judging from the course of this case, Dr Beer believed the case to be a benign obstruction due to pericolonic adhesions probably at one of the upper flexures. It demonstrates the great value of a valvular artificial anus in the cæcum, and how readily the patients can keep themselves immaculate under such circumstances.

## ASEPTIC AMPUTATION OF THE RECTUM AND POSTERIOR VAGINAL WALL FOR CARCINOMA

DR BEER presented two cases to illustrate a modification of the usual Kraske technic, which permits of an absolutely clean dissection and amputation of the rectum without opening the bowel till the wound is well sealed. Both cases had their growths in the same place, involving the

anterior circumference of the bowel, and were so close to the vaginal wall that it seemed involved. The growths were about the size of a silver dollar, ulcerated, and of the type of adenocarcinoma. In both cases the operation could be preceded by a thorough emptying of the bowels by castor oil, as there was no stenosis.

The modification of the usual technic was as follows. The anus was sewed together with heavy silk. Then a flap of skin was dissected up from around the closed anus and this was in turn sewed over the closed anus, so as to avoid any leakage during the subsequent steps. After removal of the coccyx the gut and tumor were dissected free into the peritoneal cavity in the typical way, ample gut being brought down so as to fit readily in the upper angle of the incision. Then a heavy silk ligature was tied around the gut just beyond the skin level, and the wound in the soft parts was almost completely closed by sutures. The sigmoid was attached in the wound by sutures through its outer coats. The wound was dressed with vaselined gauze and then a clamp was placed upon the projecting piece of closed gut and its contained tumor, about one inch from the heavy silk ligature. With cautery the section was then made, removing the rectum and posterior vaginal wall without contaminating the wound.

Depending upon how the patient stood the complete occlusion of the gut, the wound was left alone. When distention developed, the silk ligature was cut from the sigmoid and a tube inserted. During these three to five days, the period in which in these cases the total occlusion lasted, the complicated wounds had an excellent chance to heal, and the patients made a rapid and uneventful recovery.

#### TUMOR OF THE CAROTID BODY, EXCISION WITH LIGATURE OF THE CAROTID ARTERIES

DR WINFIELD S SCHLEY presented a man, thirty-seven years of age, who entered the hospital in April, 1916. He presented at that time an oval mass about an inch and a quarter long by three-quarters of an inch broad just internal to the middle of the right sternomastoid. He declared that it was first noted twenty years ago (about the age of seventeen), and has slowly increased in size, more rapidly the last two or three months. The skin and subcutaneous tissues were movable over it, but the mass was considerably fixed. A distinct pulsation was transmitted and expansive in type. It was possible to reduce the size of the tumor by digital compression. It would expand fairly quickly on relief of pressure. There were no other masses or glands left. Wassermann not taken.

A four-inch incision was made along the sterno-mastoid. Dissection, difficult because of innumerable venous and small arterial communications, especially at the upper pole. Carotid was compressed by finger after the tumor mass was dissected free. It caused no apparent change

in the pulse, color, or respiration of the patient After five minutes it was ligated with two strands of No 2 chromic Above, the artery on emergence from the growth was of the diameter of crow quill (4 mm) This fact, together with the apparent hopelessness of dissecting free and the feeling that it was possibly malignant, decided the question of *excision of the carotid*

Douglas reported a case in 1909 and referred to Keen's paper with 27 collected cases (operative) with a 27 per cent mortality—due principally to pneumonia from cutting vagus Four cases had recurred to time of report, with one death and the other three with death in prospect

*In 18 cases all three carotids were ligated*

Douglas also collected five additional cases, with two deaths up to time of report (one operative, from hemorrhage and shock, and one from recurrence) Thus making 32 operated cases up to 1909 Operative mortality, 25 per cent Recurrence in nearly 20 per cent

Callison and Mackenty in April, 1913, collected 29 more cases in living and one autopsy case Up to 1913 about 61 cases, with 54 *operative* Of these In 4 no removal attempted *All three carotids ligated in 32* In 15 cases the tumor was dissected away from vessels *In 8 cases recurrences occurred after dissecting away from vessels, but in only 2 cases after removal of carotids*

Of the 54 cases operated upon, 42 have recovered (operative recovery), and 12 died Ten more died from recurrences, local or metastatic, making 22 deaths in 54 cases operated up to 1913

Causes of death given as pneumonia, hemorrhage, cerebral anæmia, œdema of the lungs, and sepsis

There has been hemiplegia with aphasia in 4 cases, temporary or lasting laryngeal or facial paralysis in a number

Winslow, in May, 1916, reported two more and collected 12 additional cases, making about 75 reported cases up to that time, the case presented to-night making the seventy-sixth found It conformed in detail with those reported in the literature It was of long duration for the most part It had attached itself to and compressed the carotid, and had many vascular connections with difficult dissection It was felt that it had involved the carotid wall so as to be dangerous to attempt separation The external carotid was not seen, and the common carotid at its emergence from the growth so narrowed that circulatory disturbance was not considered likely on ligation, compensation probably having occurred or collateral circulation developed through external carotid The added risks and seriousness of the carotid excision were carefully weighed, but it was felt that we were dealing with potential, if not actual, malignancy The only post-operative condition of any note was the huskiness of the voice for several weeks, now practically gone

The chief interest lies in the common carotid excision, favored un-



questionably by the existing compression of the vessel, and the excision of vessels with growth as promising greater chance of cure, as is well shown in the collected cases. Ligation of the *common* carotid may be safer procedure in some conditions than ligation of *internal* and *external* simultaneously, as in the latter condition we prevent collateral circulation through the medium of the external vessel.

An examination of this specimen after its return by the pathologist shows that all three carotids were included in the ligatures and excisions. The external coming off from the common and overgrown and compressed by the mass, was not recognized at the time, so small was it at its exit from the growth. The case is therefore one of excision of carotid body tumor with common, internal, and external carotid arteries.

#### CHRONIC SUPPURATIVE OSTEOMYELITIS

DR WALTON MARTIN presented three cases of chronic circumscribed suppurative osteomyelitis, or the so-called chronic abscesses of the tibia, described first by Brodie.

They illustrated the circumscribed abscess in bone shut in by thickened and sclerotic osseous tissue and remaining latent for twenty or thirty years. In all of them active microorganisms were obtained, yet they all healed promptly after removal of the roof of the bone cavities and pyogenic membrane.

They presented a very different picture from ordinary acute osteomyelitis.

In all three cases the radiographs had failed to differentiate the abscess cavity from the shadow made by the thickened sclerotic bone.

#### ECHINOCOCCUS DISEASE OF THE KIDNEY

DR J J RUSSELL read a paper with the above title.

DR WILLIAM A DOWNES said that he presented a case of echinococcus cyst of the kidney before the Society about two years ago. This case was not diagnosed beforehand, it was a very large tumor in the left kidney and was removed with a great deal of difficulty. Diagnosis was made during the operation by the fact that the capsule broke and the cysts were recognized. Recovery was rather slow, as the wound became infected, but he eventually made a good recovery. About a year ago he was still well. He has not been heard from since.

He also was an Italian.

DR EDWIN BEER called attention to one point in connection with the diagnosis based on the history, which may be very misleading. He had seen one case of echinococcus on Dr Moschcowitz's service, and he had seen one case in which the clinical history of the passage of lima-bean-shaped masses suggested echinococcus. But these proved to be a type of proteid concretion formed in the pelvis.

DR ARPAD G GERSTER said that about twenty years ago the case

of a patient suffering from hydatids of the kidney was presented in a paper printed in the June issue of 1897 of the American Journal of Medical Sciences. The patient was a woman, twenty-six years old, pregnant in the sixth month. Years before, one of her duties used to be the feeding of dogs.

For a long time dull pain was felt in the right loin. It became more severe from the third month of her pregnancy on. A large tumor developed, could be easily palpated, because she had lost much flesh. There was no fever and the urine did not present any characteristics that would point to this trouble with one exception. A few days before seen she had passed a number of grape-like bodies which were immediately recognized as hydatid cysts. Thus the diagnosis was made easy.

Aside from its rarity, there were other unusual features present which rendered treatment exceedingly risky and difficult. Relating in chronological order the surgical procedure adopted, he gave a picture of the pathological conditions. On attempting puncture, a stout needle was broken by a resistance comparable to that of bone.

The mass was ovoid in the main, about the size of a cocoanut, presenting at its anterior and inferior aspect a secondary knob-like projection of lesser size and softer consistency, which was very tender. The bulk of the mass was not sensitive at all and of stony hardness.

After exposure it was found that the projecting node of the mass was the remnant of the kidney. About three-quarters of the organ were still intact, masquerading in the guise of an attachment to the tumor. The trouble had started from the upper pole of the kidney, the mass projecting upward to the seventh rib and extending downward to the level of the umbilicus. The calcareous envelope of the mass proved so resistant that entrance had to be made by the use of a resecting knife and a small saw at the cost of much labor. Finally a square-shaped trapdoor, as it were, could be raised, when it was found that the calcareous shell was filled with the well-known dense conglomeration of membranes resembling the outside silky envelope of a red onion.

The first thing done then was to evacuate. All this material was scooped out. The hemorrhage following this was considerable, it must have come from an organized lining of the inner surface. The walls of this cavity consisted of dense, calcareous plates (some of them a quarter of an inch thick), each segment irregular as to periphery, its convex surface, however, in strict conformity with the ovoid form. The segments were held together by connective tissue, the lines of union resembling those of infantile cranial sutures. Evidently the inner lining drew its blood supply from the vessels of these sutures.

Cases of complete calcification of the sac of a hydatid cyst are extremely rare.

Simon, of Heidelberg, was the first to operate upon a calcareous hydatid cyst of the kidney. He warns against attempts at extirpation. The

connection of the sac with adjacent cavities, such as the pleura, pericardium, and peritoneum, is close and extensive. Dissection without invading the cavities is rarely possible. In Simon's case this advice was sound, for he had to deal with a case of incomplete calcification. The calcareous plates did not offer an insurmountable obstacle to a cure, for they did not hinder the collapsing of the sac. The shell being complete in my own case, such an approximation of the walls was impossible as long as the calcareous matter remained in place. The woman's condition was poor, she was pregnant, and an inevitable process of prolonged suppuration was a serious menace. There was, therefore, no choice. We had to go ahead. When the packing was removed, with which the cavity was filled at the first operation, we found the shell rigid like that of an unbroken egg and unyielding even to energetic efforts at crushing by external pressure. The successive dissection of these calcareous plates had all to be done with the knife, step by step, under great difficulties.

The pleura was widely opened, failing cardiac function, due to the collapse of the lung, was overcome by immediate plugging and artificial respiration. The situation was desperate, but persistence was rewarded by complete success, for, the syncope being overcome, the woman left the table alive, though in a state of deep depression. Of course, the peritoneum was also opened as a matter of necessity, for the wall of the sac was inseparably incorporated with this membrane. Repeated and dangerous attacks of cardiac failure had to be combated for two days with every known method of restoration.

Finally she emerged from danger and made a complete recovery. The cavity contracted and closed rapidly. The patient was discharged cured three weeks after the second operation. The pregnancy miscarried.

It may be added that, as a matter of course, the healthy portion of the affected kidney was preserved.

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## CONSERVATISM IN SURGERY

THE PRESIDENTIAL ADDRESS DELIVERED BEFORE THE AMERICAN SURGICAL ASSOCIATION,  
BOSTON, MASS., MAY 31, 1917

By SAMUEL J. MIXTER, M.D.

OF BOSTON

FELLOWS OF THE AMERICAN SURGICAL ASSOCIATION.

You have honored me by choosing me to be your President, the highest honor that can come to an American surgeon. My appreciation of that honor is all the greater because it is more than I deserve for work accomplished, and is a mark of your affection and esteem, of your feeling that I have at least tried to "do my bit" in bringing American surgery to the position it occupies to-day. Gentlemen, I thank you with all my heart.

In these days of war and peril, of struggle of Right against Wrong, of awful waste of human happiness and human life, when we are just preparing to fight for our lives and all that is near and dear to us and humanity, the medical profession must do its part.

A year ago our President, Dr. Le Conte, urged upon us and the country the necessity of medical preparedness, but how little of the necessary work has yet been done. The army needs, and must have, young, hospital-trained medical men to care for the troops to be used in this country and abroad, and these men must have special training for their work if they are to serve efficiently. It is our duty as older men to aid in this movement. Let each one of us try to do his part in securing enlistments either to the Medical Corps of the Army, or to the Medical Department of the Officers' Reserve Corps.

All honor to those members of our Association and other medical bodies who are now working at home or abroad, helping to throttle the rabid beast of the world, the bite of whose poisoned fangs can only be cured by one antitoxin. Now, if never before, we strive for Peace with Victory. Some are now "Somewhere in France," more are going with hundreds of younger men to work for those of us who are forced to stay behind, facing dangers that we cannot share.

The death rate in the Medical Corps has always been high, but it is bound to be higher, for it has remained to be the crowning shame of Ruthlessness and Germany that a supposed civilized nation refuses to recognize the cross on the arm or on the side of a hospital ship, sending wounded men and Red Cross nurses to the same death to which they sent that splendid

woman, our friend and companion, Marie Depage The greater the danger, the greater the honor, and we know that our doctors and our nurses will not be found wanting, but ready to face danger whenever and however it comes, whether from disease, shot and shell, or the viper of the sea

What has all this to do with "Conservatism," which is the theme of this paper! Much—everything War is the highest type of conservatism when it is waged in the defense of our homes and the rights of humanity Nations, like surgeons, must resort to steel to accomplish their beneficent purposes, and the one who uses it hesitatingly or inefficiently through inadequate training or cowardice spreads broadcast the germs of physical or moral disease

War being a fact, and not a theory, each one of us must ask what he can do to help toward a speedy and successful end What can those of us do who are debarred by age, physical disabilities, or other reasons from taking the active part that we might wish? The absence of so many of the younger and more active men will throw on us services that we thought we had finished in hospital and private practice The sick must be cared for, the young so treated that they grow up strong and lusty to take their part when the time comes, and the possible mothers so strengthened that they may bear healthy children to supply the place of those brave men and women who will be lost to the nation There will be hard work and plenty of it for us all

One very important subject for careful thought and action is the prevention of venereal disease, the curse of armies and navies the world over, but especially to be feared when young soldiers are brought together in mobilization and training camps, as shown in the present war and our late experience on the Mexican border Every effort should be made to guard our men so that they may be kept well and efficient and return home clean and healthy Shot, shell, and exposure are not the only means by which an army may be weakened In this connection I feel that it is highly important for our Association to take some formal action urging the abrogation of the patents on salvarsan, a remedy at present practically unobtainable, though absolutely necessary for the present and future treatment of syphilis

At a time like this, what more fitting topic of thought can we have than Conservatism—when everything tends toward exaggeration

New problems are facing the surgeon in civil as well as in military life, as they always have and always will—and our old foes, sepsis, tuberculosis, and malignant disease still claim their victims in peace as well as in war We are fighting them hard, but we must fight them still harder if we expect to win Popular education in the early recognition of suspicious symptoms, laboratory and bedside study, early, thorough, and judicious operation, are to-day the best weapons we possess, and let us use them to the best of our ability.

Advances in Surgery are made slowly, step by step, through careful observation, experiment, and skilful manipulation—seldom by isolated bril-

hiant dashes It was my privilege to see the first, in fact, the first sixteen litholapaxies of Bigelow Even the first operation was brilliantly successful, and the onlooker could hardly believe that it was the first, everything went so smoothly and successfully It was only after looking over all the discarded apparatus, the great number of anatomical preparations and experiments, that one could understand the reason for the success That first operation was the result of months and years of hard mental and manual labor No matter how brilliant the idea, if crudely and carelessly carried out, it cannot be expected to bring success I have always looked upon the preliminary work of Bigelow in perfecting his operation as one of the greatest lessons of my life, and it is to be regretted that the whole collection of broken, twisted, and discarded steel, rubber, and glass, the plaster casts of the bladder, with the various instruments in place, could not have been preserved and their history written for the benefit of those who would try short cuts in surgery

In the program for this meeting there are papers on the treatment of intestinal stasis, in fact, the subject comes up at nearly every large surgical meeting, a sure sign that perfect success has not been attained Because the intestine could be removed or sidetracked and the patient still live, men, having seen or heard of certain cases—successful or early reported as such, whether they were possessed of the necessary surgical skill and judgment or not, began to try all sorts of mechanical tricks with the offending organ, with the net result of a few cures and many failures Do not understand me as condemning such operations in toto, for in suitable cases a properly selected surgical proceeding may be useful or necessary, but let it be carefully thought out and carefully executed Few of us are guiltless of mistakes in this field of work We have followed too blindly and enthusiastically in the footsteps of the first explorers, have worked by rule of thumb, instead of being thoughtful and caretaking

Working by any fixed set of rules is sure to be followed by disaster. There is practically no surgical rule that should not occasionally be broken. It is better to open the trachea with a dirty knife and unclean fingers, than have a person choke to death, it is better to leave an occasional septic appendix or gall-bladder to drain, even if we believe in their routine removal—and this is where that something called “surgical judgment” comes in Many a brilliant operator is a poor surgeon A man should never let his deft fingers tempt him to useless or unnecessary work This is so often done in the treatment of advanced malignant disease, and the result is either the death of the patient—which is not to be so much regretted perhaps—or he is left after unnecessary pain, both mental and physical, in a worse state than before Fortunately, we have X-rays and radium to suggest, as they may relieve the pain and other symptoms in certain cases, even if they do not cure, and there is plenty of morphine in the world that may be used judiciously and freely toward the last Too often an operation is done because the patient insists, and against the better judgment of the surgeon.

The result of the discovery of the curative value of the X-rays and radium is a good example of the danger of a non-conservative use of a valuable remedial agent. They were hailed as cure-alls in the treatment of malignant disease, and we all knew of cases of even beginning cancer of the breast that were X-rayed to death, when a thorough operation would probably have saved the patients. Misdirected enthusiasm ran wild, and I can to-day repeat that statement that I have made before, that, so far as they were used for the cure of malignant disease, more lives were lost than would have been the case had X-rays never been discovered. Let us hope that this statement may not be made of radium and of serum therapy. How often has a new remedy or method of great value in itself been discovered and published to the world, and then, when adopted by would-be followers or imitators, the result has been disaster to patients and the discredit of the method.

Within our own time what a long list of misused surgical and remedial methods could be compiled. Normal ovariectomy, so called, unsexed thousands of women for whose relief from every known ill from dysmenorrhœa to epilepsy was sought, and to-day the appendix is removed for the relief of symptoms due to trouble in some other organ which, from lack of knowledge or due care, has been overlooked. There are bound to be in every profession men who are careless, untrained, overenthusiastic, and rash.

The "near-surgeon," to use a favorite term of one of our members, is a dangerous man, and by example, precept, and teaching he must be raised to a higher level. All men have not the same minds, hands, or hearts, and even the best can always learn and advance if they will, for there is no such thing as standing still. With the broadening of the surgical field many more surgeons are needed than in the past, and all young men cannot have what we may call an ideal training, but must work ahead as best they may amid unfavorable surroundings, mental and physical. Some of these men become better surgeons than those who have had every advantage, for some men never become real surgeons, no matter how many operations they may do. The question of the incompetent or conscienceless surgeon is one of most vital interest to-day and one whose solution it will be hardest to find.

Conservatism in surgery means the best use in our power of the means at hand for the saving of life, the relief of pain and deformity, without unnecessary mutilation. The man who is timid, the man who is rash are alike far from being conservative—amputation when necessary to save life may be the highest form of conservation, and, if it is best to amputate at or above the knee for gangrene, the foot alone should not be taken off because the shock is less and the immediate mortality lower.

Timidity in the treatment of malignant disease is a common fault, the highest type of cowardice. True conservatism means going to the "anatomical jumping-off place," for no death is more to be dreaded than that from recurrence. Above all, is he a knave as well as a coward who refuses to operate on a desperate case, when life may perhaps be saved, for the

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sake of his "statistics"—statistics which have morally damned many an otherwise good surgeon, had better be juggled in some other way or even lied about. The true surgeon is never "fearless." He fears for his patients, he fears for his shortcomings, his own mistakes, but never fears for himself or his professional reputation. His fear makes him a better man.

In the course of a somewhat busy professional life I have found my standard of the true surgeon growing ever higher and higher, and, even to a body of picked men such as this, it is not out of place to speak of the ideal, for who among us has attained or ever will attain the goal toward which he strives? Were it not for the unattainable the world would indeed be a poor place. Those qualities that make the true man in any walk of life are doubly necessary to the making of the Real Surgeon.

Self-reverence, self-knowledge, self-control,  
These three alone lead life to sovereign power,  
Yet not for power (power of herself  
Would come uncalled for), but to live by law  
Acting the law we live by without fear,  
And, because right is right, to follow right  
Were wisdom in the scorn of consequence

The present meeting of the Association promises to be small, numerically, so many of our members having already gone to the front or are soon to go. We have lost our secretary, our treasurer, and many others who are working for us and ours. What better men could we have to represent us and our country, knowing as we do that they are good men and true, real Surgeons, ready to do their part and more, for the Right. We hope and trust that we may all be together at future meetings in happier and more peaceful years—those already back from the front, those now at their posts, those still to go, and those who are left at home. Our next meeting may be smaller yet, so let us train ourselves and the younger men that the line across the sea shall never be broken until we have "Peace with Victory."



# THE CARREL METHOD OF TREATING WOUNDS \*

BY CHARLES LANGDON GIBSON, M D

OF NEW YORK

SURGEON TO THE FIRST (CORNELL) SURGICAL DIVISION OF THE NEW YORK HOSPITAL

THE great value of the Carrel method was impressed on me last year when I visited Carrel at his hospital in Compiegne and subsequently saw it carried out in the Allies' Franco-British Hospital at Annel in charge of Dr H H M Lyle, Surgeon to St Luke's Hospital, New York City, and at La Panne, Belgium, at the Ambulance of our esteemed honorary member, Professor Depage of Brussels. I have put the method into practice in my service at the New York Hospital in the past seven months, aided by a nurse who was trained by Dr Carrel and by an interne who was given special opportunities by Professor Depage to familiarize himself with the details of the method.

It is believed improbable that many institutions are properly equipped to take full advantage of the value of the method, as it is absolutely necessary to know thoroughly both the theory and the practical application of all the details. Dr Lyle was situated only four miles away from Carrel and had frequent opportunities to familiarize himself with the practice of Carrel's hospital. Professor Depage sent some of his assistants and nurses to work with Carrel and also spent some time there himself.

The Carrel method of combating infection can be described as a series of steps which may be divided into three phases.

- 1 The proper treatment of a wound (*a*) to put it into the best possible position to heal *secundum artem* and (*b*) to adapt it to the employment of a suitable antiseptic.

- 2 The use of an antiseptic which will destroy the bacteria and neutralize the toxins without injuring the tissues or diminishing the normal process of repair. The antiseptic which has been found to conform to these requirements is the Dakin's solution of sodium hypochlorite.

- 3 The conversion of open wounds when sterilized by the above means into wounds which can and do heal in a manner similar to ordinary operative incisions after proper preparation and suture.

The popular conception of the Carrel method is the employment of a solution of sodium hypochlorite which generally will not conform to the requirements of the Dakin solution and applying it to wounds indiscriminately with little and generally no knowledge of the factors necessary to success or the drawbacks or dangers.

If the Carrel method is put into practice imperfectly poor results must

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\* Read before the American Surgical Association, June 1, 1917

## THE CARREL METHOD OF TREATING WOUNDS

follow and the method will fall into disrepute and its great value become lamentably obscured. While there is nothing mysterious or difficult in the method it does require intelligent application of each and every detail which its author worked out step by step and for which he has a definite reason backed by scientific investigation.

The importance of this meticulous care was demonstrated when the principal operator of Carrel's Hospital was detached and replaced by a surgeon equally experienced and competent, but unfamiliar with the method. Notwithstanding the continuity of the rest of the personnel Carrel told me that it took about a month for the later arrival to become familiar with the factors necessary to complete success.

The practical applications of the Carrel method have been well described in the article by Dr H H M Lyle in the Journal of the American Medical Association, January 13, 1917, and Dr William O'Neill Sherman, in Surgery, Gynecology, and Obstetrics, March, 1917, which I recommend strongly to the attention of all those interested in the subject<sup>1</sup>. I shall, therefore, more particularly take up some of the theories on which the method was worked out. These are lucidly explained in the recent book of Carrel and Dehelly, "*Le Traitement des Plaies Infectées*," and I will give an epitomized translation of the principles as outlined by them in the following pages.

The choice of a substance best fitted to sterilize an infected wound depends in addition to its germicidal qualities upon the numerous other factors such as its irritating character, toxic power, solubility, capacity for penetration of the tissues, its absorption by the tissues, and its reaction with the proteins and other constituents of the tissues. The destruction of the bacteria by chemical action is due partly to the action of the antiseptic and partly to the changes it produces on the proteins or other substances making up these bacteria. Microbes in an aqueous solution are easily destroyed by antiseptics, as the mixture contains no other proteins. Microbes which are found in blood serum, pus, or other exudates are harder to destroy, as the antiseptic acts not only on the microbes but also on the proteid matter contained in such media. Therefore, the germicidal action of an antiseptic must be tested under the last described conditions and not simply in an aqueous solution. The germicidal activity of all the known antiseptics is much diminished by the presence of blood, serum, or similar substances. In such conditions this diminution is so great that the substances employed become inert. After comparing the numerous agents with regard to bactericidal action and possible irritation of normal tissues, Dakin favors neutral hypochlorite of soda and also chloralmines.

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<sup>1</sup> "Disinfection of War Wounds by the Carrel Method," by Dr H H M Lyle, of New York, Journal of the A M A, January 13, 1917.

"Carrel Method of Wound Sterilization, Its Use in Military, Industrial, and Civil Practice," by William O'Neil Sherman, of Pittsburgh, Surgery, Gynecology, and Obstetrics, March, 1917.

*A—Dakin's Hypochlorite of Soda*—The antiseptic properties of sodium hypochlorite have long been known. It cannot, however, be utilized in wound sterilization in the form of Javel water or Labarraque solution, as these are irritating and may seriously damage the tissues. Dakin, therefore, sought to diminish this irritating action of sodium hypochlorite without modifying its antiseptic action. (The reader is referred for details to Dakin's article in the British Medical Journal, 1915. It may be stated that the modification consists in the neutralization of the free alkali which when present has caustic properties.)

*B—Bactericidal Action of Dakin's Solution*—The results of experiments in vitro are of little significance, as the conditions differ so greatly from the practical use. In wounds a small amount of pus is in contact with a large amount of the antiseptic and the hypochlorite solution is frequently renewed. In the laboratory tests the action of the hypochlorite on the microbes suspended in the pus is of short duration. If at the end of two or three hours one tests the amount of hypochlorite obtained in the mixture one finds sometimes a complete disappearance of the hypochlorite, as it rapidly combines with the proteins of the pus and cannot be recovered as such. Because of this rapid disappearance of the Dakin solution when mixed with wound secretion it must be instilled into wounds either continuously or, if intermittently, frequently. This ignorance of the chemical characteristics of the hypochlorites has led some surgeons to manifest astonishment, because a mixture of pus and hypochlorites after some hours incubation makes a medium in which bacteria grow readily. It is self-evident that these mixtures after such treatment no longer contain hypochlorite.

The bactericidal action of the Dakin solution has been studied in infected wounds. If it is applied to a wound so that its concentration is constant and its application is prolonged the microbes disappear. This fact has been amply demonstrated. It is wise, however, to determine if the treatment is the principal cause of the sterilization and if this sterilization is due to the sodium hypochlorite.

(a) It might be inferred that in these cases wounds become spontaneously sterile. In reality, this occurrence is improbable, as one never sees a series of infected wounds become sterile in a few days, but this hypothesis was worked out experimentally. In one corner of a wound, all parts of which were uniformly infected, there was placed a piece of filter paper kept constantly wet with hypochlorite. A piece of similar size was put over another portion of the wound and the whole wound covered by a protective dressing. After twenty-four hours the granulations under the hypochlorite paper were smooth and red and the bacteria had entirely disappeared. Under the other paper the granulations were irregular and pale and the bacteria were undiminished. In the rest of the wound not covered by these two filter papers the quantity of the bacteria was unchanged.

In a wound, half of it dressed with hypochlorite, the other with vasc-

line, total disappearance of the bacteria was obtained on the hypochlorite half, with persistence of the infection in the other

Similar results were obtained in deep wounds. Two shell fragments were lodged in two continuous wounds in the lumbar region. Both fragments were removed at one sitting. One wound was treated by intermittent instillation of the hypochlorite, the other by an ordinary dressing. The first wound remained painless and the bacteria disappeared completely from the smears obtained from the wound. The other became painful, was surrounded by a red areola and developed a streptococcus infection. In perforating wounds it was frequently noted that the region where the hypochlorite was instilled was sterile, while at the other end where the hypochlorite did not penetrate there were numerous bacteria. Numerous similar observations demonstrated convincingly the relation of cause and effect between the treatment employed and the results obtained.

(b) It may be asked next if the result is due to the antiseptic action of the hypochlorite or to the mechanical action of the instillation of the liquid. The following experiments were made as bearing on this point. A patient had on his thigh two wounds of approximately the same dimensions and of a similar bacterial content. One wound (No. 1) was treated with the hypochlorite solution, the other (No. 2) with physiological salt solution. At the end of twenty-four hours No. 1 showed not a single microbe to a field, while in No. 2 there were more than thirty to a field.

Similar experiments were made on superficial wounds on which were placed squares of filter paper of the same size. At the end of twenty-four hours the area covered by the filter paper wet with hypochlorite contained no microbes, that treated with saline contained many. (Experiments of treating infected wounds alternately with hypochlorite and saline gave convincing proof of the beneficial action of the hypochlorite.)

*C—Action of the Hypochlorite on the Microbic Toxins*—Several c.c. of pus were obtained from a grave case of tetanus and divided into halves. To the first was added two parts of hypochlorite solution 1/100, to the second an equal amount of 8 salt solution. At the end of an hour 1 c.c. of each of these mixtures was injected into guinea-pigs. The guinea-pigs injected with the salt solution died of tetanus in eight to ten days, the others who had been injected with the pus treated by hypochlorite presented no signs of tetanus and survived.

Similar experiments with filtrations were made with the same results.

*D—Toxic Action of the Dakin's Solution*—Sodium hypochlorite has very little toxic properties when introduced on the surface of wounds or into the subcutaneous cellular tissue of animals. It is dangerous if introduced into the circulation. It is strongly hæmolytic. It should not be injected into a vein or injected under pressure in deep wounds lest it be absorbed by the tissues.

*E—Action of the Hypochlorites on the Tissues*—If the Dakin solution is applied to a wound surface for several days, and occasionally for several

weeks, it will not usually cause any marked irritation. The action of the hypochlorite on the tissues is, however, much more marked in vitro than in vivo. In the wound non-vascularized tissues become dissolved and the surface rapidly becomes clean. If the integrity of a blood-vessel wall is affected the slough comes away quicker than in the usual wound healing. In the same way clots plugging vascular wounds may become dissolved by the action of the hypochlorite. It is, therefore, important to investigate carefully the conditions of vessels in the wound and make a particularly careful hæmostasis.

*F—Mode of Action of Hypochlorites*—Dakin attributes the germicidal action to a chemical reaction similar to what occurs with ammonia and hypochlorite.

In the sterilization of a wound the antiseptic performs the same function as does the scalpel in an operation. It is, therefore, only an instrument and does not constitute a method. The choice of a good instrument is essential to success. The chloralmines and the hypochlorites of Dakin are admirable instruments.

As Dakin's hypochlorite possesses the advantage of being strongly bactericidal and irritates the tissues very little, and at the same time is easily and cheaply obtainable, it would seem to be the antiseptic of choice during this war.

#### THE CONTACT OF THE ANTISEPTIC AND THE MICROORGANISMS

The antiseptic solution, sterilizing only what it touches, must come in intimate contact with the organisms infecting the wound. In order to know whether or not the antiseptic treatment could be applied to infected wounds, it became necessary to study the infection both of recent and infected wounds and determine the possibility of bringing the antiseptic into contact with the microbes.

*A—Topography of the Infection*—1 The topography of the infection was first studied in fresh wounds, superficial or deep, with or without fractures. The smears were taken in different places, around projectiles, fragments of clothing, splinters of bone, and on their surfaces, and examined microscopically and cultured.

In the first few hours the smears were generally negative, but the cultures were positive. The apparent sterility of the smears was due to two causes—dilution by the blood of the microbes and their relative infrequency in the early period of the infection, for they need time to multiply.

At the end of twelve hours the bacteriological examination showed bacteria more constantly and in greater numbers. The wounds showed some reaction and the polynuclear cells became more or less numerous.

In twenty-four hours the topography of the infection had changed considerably, the bacteria were no longer localized on the surface and around the foreign bodies, the smears showing their presence throughout

## THE CARREL METHOD OF TREATING WOUNDS

the greater part of the wound. At the same time an increase of the polynuclears was noted. That is, in the first twenty-four hours there was a multiplication of the microbes on the surface and in the vicinity of the foreign bodies, especially pieces of clothing, and later their diffusion in the limits of the wound. The difference bacteriologically in a wound from the fifth or sixth hour to the twenty-fourth hour was due to the rapid multiplying of the microorganisms.

The study of the numerous wounds showed that the organisms generally remained on the surface rather than penetrating deeply into the intermuscular spaces or the lymphatics. They invaded blood clots and devitalized tissues, and they followed extravasated blood in the vascular tracts and thus could reach the fractured bones. Habitually, however, in the first few hours, sometimes the first few days, they remained on the surface, that is, within reach of a solution, if such a solution was introduced under favorable conditions. This fact was well demonstrated in the wounds. When the antiseptic solution was brought into contact with the infected surface the number of bacteria rapidly diminished and the wound shortly became aseptic.

Suppurative wounds, therefore, were sterilized within twenty-four hours, the deeper, even accompanied by compound fractures, in five or six days. It was possible indeed when the treatment had been applied at the start to close such wounds by deep sutures and get results comparable to those of primary union.

2 Suppurating Wounds.—During the period of suppuration it was generally more difficult to bring the antiseptic in contact with the microbes, but, depending on the form and nature of the wounds, microbes were more or less easily influenced by the liquid. The chief difficulty was in dealing with necrotic tissue and sloughing tendons and aponeuroses, which prevented the action of the antiseptic on the microbes, with persistency of infection. Re-infection is, of course, more probable in such wounds, rendering it more difficult to obtain primary union after suture. It is therefore most important to sterilize the wound at the earliest period of infection.

*B—Preparation of the Wound for the Introduction of the Antiseptic—* This preparation consists above all in the mechanical cleansing of the infected regions. Free incisions of the soft parts permit of such a cleansing even in compound fractures. It is known that the pieces of clothing, projectiles, detached bony fragments, blood clots, and necrotic tissues harbor the bacteria and protect them against the antiseptic. Therefore, all such foreign bodies must be carefully sought for and removed. Fragments of clothes are the principal source of infection. Necrotic tissues are the favorite habitat of the gas bacillus. Systematic resection of all the tissues, skin, aponeurosis, and muscles which are devitalized, as practised by Depage, is an excellent procedure and should be generally employed. The surfaces of bony cavities in which pro-

jectiles have been imbedded should be scraped or resected. It should be noted that tampons placed in wounds efficiently protect microbes against the action of the antiseptic.

Incisions should be planned to expose all recesses of the wound as much as possible. The liquid must penetrate everywhere and remain in contact with the infected surface so long as necessary, that is, the weight of the liquid plays an important part. Wounds which can be filled as a vase are most suitable for sterilization (Fig 3<sup>1</sup>). Therefore, incisions should be preferably located on the anterior surface of the limb without a posterior counter opening, thus retaining the liquid in the cavity and completely bathing its walls.

#### I TECHNIC OF THE MANUFACTURE OF DAKIN'S SOLUTION

One of the essential conditions for the sterilization of wounds requires, as is well known, a substance which can be used a long time on the wounds in a fixed concentration without producing irritation. The proportion of alkali in Javel water and in Labarraque's solution is capable of dissolving the skin if contact is sufficiently prolonged. Dakin, therefore, sought to obtain a solution free of caustic alkali, and the hypochlorite contained should strictly fall between 0.45 and 0.50, below 0.45 the solution is not sufficiently active, above 0.50 it is too irritating. The earlier solution of Dakin has been modified by Daufresne. It is as follows:

To make 10 litres of the solution

1 Weigh exactly chloride of lime, containing 25 per cent of active chlorine, 184 gm, dry carbonate of soda, Solvay, 92 gm (or crystalline carbonate of soda, 262 gm), bicarbonate of soda, 76 gm

2 Into a 12-litre jar put the chloride of lime and 5 litres of ordinary water. Stir vigorously two or three times and let it settle over night.

3 Dissolve the carbonate and bicarbonate of soda in 5 litres of cold water.

4 Pour the whole solution of salts of soda in the vessel containing the macerating chloride of lime. Stir vigorously for a minute, then let it settle to allow precipitation of the carbonate of soda.

5 In half an hour siphon off the clear liquid and filter it with double filter paper to obtain a perfectly clear fluid, which must be kept in a cool place and in the dark.

The antiseptic solution is then ready for surgical use. It should contain 0.475 of the chloride of lime, with small quantities of neutral soda salt. It is definitely isotonic to blood serum.

The proportion of 184 grammes of chloride of lime to 10 litres of water corresponds to a product of good average quality (25 per cent of active chlorine), but variations from the above are frequently encountered.

Daufresne has constructed a chart which gives the proper proportion

## THE CARREL METHOD OF TREATING WOUNDS

of ingredients according to the amount of active chlorine contained in the chlorinated lime as determined by titration

Titer of chlorinated lime	Chlorinated lime, Gm	Anhydrous sodium carbonate, Gm	Sodium bicarbonate, Gm
20	230	115	96
21	220	110	92
22	210	105	88
23	200	100	84
24	192	96	80
25	184	92	76
26	177	89	72
27	170	85	70
28	164	82	68
29	159	80	66
30	154	77	64
31	148	74	62
32	144	72	60
33	140	70	59
34	135	68	57
35	132	66	55
36	128	64	53
37	124	62	52

*Preservation of the Solution*—Solutions of hypochlorite do not maintain their stability indefinitely, especially if exposed to light. Therefore, they should be kept in a dark place and should be made fresh as often as possible, at least every 10 to 15 days. (In large clinics this solution is made, and probably wisely, daily.)

*Sources of Error*—By following the rules laid down by Dakin and Daufresne the solution of hypochlorite of soda always fulfills the requirements. Experience has shown that in some hospitals where Dakin's solution was said to have been employed there was used frequently under this name variable mixtures, more or less dangerous. These defective solutions which irritate the tissues and fail to sterilize wounds were the result of more or less gross technical faults.

It is important to note that the details of the technique as described must be strictly followed if one wishes to obtain a Dakin's solution of characteristic properties, for the technic of the sterilization has been calculated on the use of a liquid containing a concentration of the properties of the Dakin's solution so that any modification of this solution robs the method of its precision and efficiency.

### TECHNIC OF THE STERILIZATION OF WOUNDS

I *Mechanical Cleansing*—The first part of the treatment consists in preparing for the penetration of the solution into the wound by surgical intervention and mechanical cleansing of the wound. This intervention is indispensable in order to effect intimate contact of the antiseptic and the bacteria.

1 The Time of the Mechanical Cleansing—The surgical intervention



and the mechanical cleansing are carried out as soon as possible after injury Every infected wound passes first through a period which may be termed pre-inflammatory—the various local symptoms being slight or absent It is essentially the period during which, as far as possible, necessary intervention must be performed

2 In from twelve to forty-eight hours, sometimes later, the inflammatory period begins, with elevation of temperature and obvious local manifestations of infection This period may last for days or weeks While the patient remains in this condition surgical intervention such as one would have done in the first twenty-four hours is not indicated Free incisions and a prolonged search for foreign bodies or detached

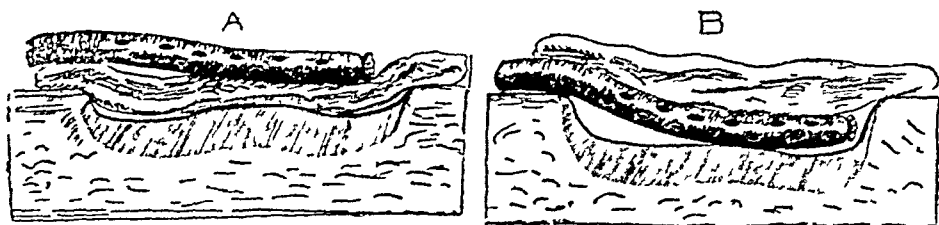


FIG 1—A, defective application of tube, B, correct application of tube

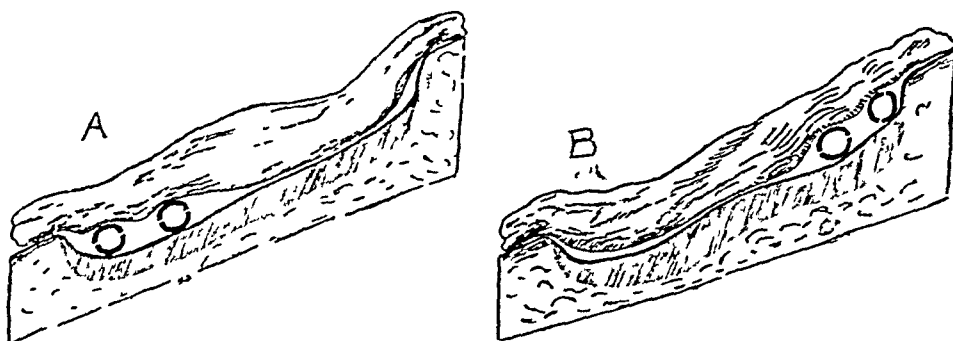


FIG 2—Oblique wound A, tubes wrongly applied at bottom of wound, B, tubes correctly applied at top of wound

pieces of bone may provoke a septicæmia or at least an aggravation of the pain and the local phenomena

3 When the period of acute infection is over and suppuration has begun, such search and procedures may be done with much less danger Osteomyelitis has, however, sometimes begun and the cleansing of the wound is no longer so efficacious as at first In other words, the most valuable time for operation is the pre-inflammatory period

II *The Technic of Mechanical Cleansing of the Wound* — 1 Both a general examination and a careful local examination must be made before intervention in order to determine the possibility of such intervention as well as its extent and the time required Armed with such information, one proceeds as soon as possible to the mechanical cleansing of the wound

## THE CARREL METHOD OF TREATING WOUNDS

2 Anæsthesia—A general anæsthetic must always be employed In certain cases spinal anæsthesia may be used

3 Incision and Cleansing of the Wounds of the Soft Parts—The skin is sterilized with tincture of iodine Wounds of entrance and exit too small to permit any examination of the course of the foreign body must be enlarged It is necessary to inspect the entire field visually, especially when a fracture exists.

No hesitation need be felt in making large incisions, as in a few days they can be closed A large incision of the soft parts generally permits of early closing

(a) An excision of the contused portions of the tract is carefully performed Depage and his followers deserve credit for showing the

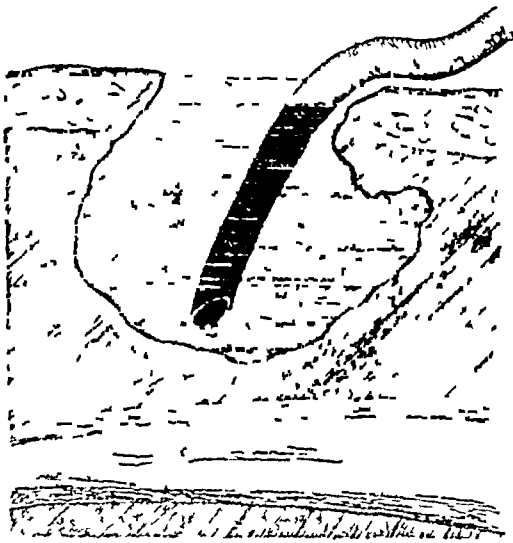


FIG 3 —Wound with opening on upper surface filling up as vase

great usefulness of pretty complete resection of the whole tract of the missile

(b) Hæmostasis—This must be performed very carefully, and it is important to verify the extent of extravasation of blood into the cellular spaces, especially when there has been a wound of a large vessel Infection spreads with great ease under such conditions and may be of a particularly serious nature

(c) Extraction of Projectiles and Fragments of Clothing—If a wound is cleansed within a few hours after injury and the foreign body is small, it is generally easy to find, as the eye can follow the route of the projectile easily It may be necessary to have recourse to some of the numerous and useful forms of apparatus for the location of foreign bodies It is even more important to remove the fragments of clothing

(d) Drainage—Free drainage must be established, but differently from the customary methods Counter openings on the dependent surface should not be made lest the antiseptic solution escape from it

#### 4 Cleansing of Wounds Complicated with Fracture of Articular Lesions

(a) Cleansing of the Site of Fracture—Incisions which serve for exploration and cleansing of fractures must always be very large. In fractures of the femur it is particularly important to make a large incision and separate the muscular bundles in order to follow the bony fissures to their full extent. Loose spicules of bone are often found between the fractured surfaces and in the medullary canal. These should be removed. The medullary canal is explored in longitudinal fractures and the marrow should be removed. All fragments adherent to the periosteum are preserved, as experience has shown that fragments so treated are sterilized without sinuses and become readily united. On the other hand, the very free removal of these fragments so often performed in the field ambulances has given deplorable functional results. Bony lesions, often the severest, should not be submitted to immediate amputation except in extensive crushing of the bone or in the destruction of the vascular nervous bundles. In this way it is possible to preserve limbs which otherwise would be destined to amputation.

(b) Cleansing of Articular Lesions—When the synovial membrane alone is affected the projectile is removed and the articulation emptied of blood. The infected region is isolated from the rest of the region by compress or suture, and the instilling tube is placed at the site of the foreign body. If the bony lesions are very extensive, resection may be necessary. Primary articular resection must be made circumspectly, for a chemotherapy often results in healing of extensive lesions which under any other treatment would require resection.

#### INFLAMMATORY PERIOD

The inflammatory period generally begins in twenty-four to thirty-six hours—sometimes later. Two forms of infection are observed, the gangrenous and the phlegmonous. The first is of a more rapid evolution.

Our line of conduct will vary according to whether the infection is gangrenous or phlegmonous.

1 *Gangrenous Infection*—This occurs in three forms—septic, grave local form, and the gaseous phlegmon.

(a) The septicæmic form requires immediate amputation, giving the patient what little chance there is for preservation of life.

(b) Local Gas Gangrene—There are two forms, the superficial and the deep. The superficial yields readily to free incisions and chemical disinfection. The deeper form affects principally the muscles. While this form may yield to free incisions and chemical disinfection, it may be necessary to perform an amputation, which is done fairly close to the limits of the infection and the stump left wide open.

(c) Localized Gas Gangrene—This is a more benign form, and

often becomes localized to a certain muscle. This form is particularly adapted to treatment with the Dakin solution.

2 *Phlegmonous Infection*—The treatment may be summarized in saying that it is different from that adapted to the pre-inflammatory period. When the infection is well developed in a wound it must be limited at first by the simplest methods and leave for further procedures the surgical treatment necessitated by anatomical lesions and by projectiles.

Secondary Hemorrhage—Such hemorrhages have occurred in certain hospitals as a result of employing an imperfect Dakin solution. The solution contains probably free alkali capable of provoking vascular ulcerations, as will Labarraque solution and Javel water. In wounds sterilized chemically, we never see secondary hemorrhages due to supuration.

C—*Period of Suppuration*—Manipulation of wounds in this period is done more cautiously, as, in a way, it coincides with the inflammatory period. There are two types. One is covered with more or less sanguineous pus and accompanied with lymphangitis, swelling, and pain. This is the period of transition between the inflammatory period and the suppurative period, properly speaking. Unless there are urgent indications, these suppurating wounds must be treated in the same manner as wounds of the inflammatory period. The other type represents the older lesions. Thick pus escapes from the orifice covered by granulations, and the tissues show no œdema. Temperature is little elevated and shows marked variation. In this period surgical intervention is as possible as in wounds of the first type.

1. Chemical Cleansing—In a great majority of these cases the wounded referred to the hospital at the end of from two to fifteen days have already been operated on. It is preferable not to interfere at once, but content one's self with minor procedures and the instillation of the Dakin solution as best one can.

2 Surgical Cleansing—At the end of a little while in all compound fractures the improvement produced by the instillation of the antiseptic comes to a standstill. The wound then may be cleansed as if it were a fresh wound.

Chemical Sterilization—The surgical cleansing is followed by application of the instillation tubes just as if it were a fresh wound.

D—*Cicatricial Period*—Cicatrization is not indicated at the end of infection. It is therefore prudent in these secondary interventions not to suture the wounds, but place in the depths one or two tubes for the introduction of the antiseptic liquid. In this way rapid sterilization of operative wounds is obtained and accidents due to re-infection are avoided. Later when the wound is determined to be really aseptic it may be closed.

## RESUME OF THE PRACTICAL APPLICATION OF THE CARREL METHOD

The method is applicable chiefly to the disinfection of fresh wounds, say within twenty-four hours from the time of infliction, more particularly compound fractures. Most of these cases will require cleansing under an anæsthetic, the thorough removal of all foreign bodies, fragments of shells, etc., with the trimming away of loose portions of tissue and the establishment of very free drainage. Instead of using gauze, ordinary rubber tubing, etc., for drainage, the wounds are filled with a large number of small rubber tubes to carry in the Dakin solution. Each tube is about the size of 16 French, perforated at the end with a number of small holes, and usually tied off at the open end to allow the fluid to run out of the smaller holes. The fluid is introduced at a pressure of 1 metre, and on account of the numerous holes of small size the fluid is forced out very much like a spray. Each tube is destined to spray a limited section of the wound, so a very large wound may require a dozen or more tubes. These tubes are coupled up by special branch tubes of glass devised by Carrel which lead to the tank containing the Dakin solution over the patient's bed. The dressings are applied largely in one piece and are made very light, the theory being not to have a big dressing into which the fluid simply accumulates.

The Dakin fluid is admitted by releasing the stopcock of the irrigator and allowing a prescribed quantity of the fluid to flow out into the small tubes every two hours. The amount will vary according to the number of tubes and the size of the wound. The object is to keep the wound damp without flooding it, and the exact amount of fluid has to be studied by the typical condition of each wound and by experience. If the fluid soaks through the dressing it shows too much is being used. The fluid is somewhat irritating and it is wise to protect the skin which may come in contact with it by cloths soaked in yellow vaseline. This procedure is better than applying the vaseline directly to the skin, and the yellow vaseline is more efficacious than the white.

The wounds are dressed daily, particularly to control the condition of the tubes and test their working efficiency. The tubes are changed or renewed according to the condition of the wound, if they do not become clogged or foul they may serve for several days.

Under this treatment fresh wounds do not develop infection, and there is practically no suppuration whatsoever. The average wound will become sterile inside of ten days. The sterilization of the wound is easily appreciable clinically from the total absence of reaction, suppuration, pain, redness, œdema, and the absence of constitutional manifestations, which are very marked.

The actual sterilization is demonstrated by the daily (or every other day) examination of the wound secretions for bacteria. From different parts of the wound a loop of secretion is taken, which is spread on a slide and stained by a suitable stain. At the beginning the number of

bacteria is infinity, but it is noted that the average number of bacteria in a given field diminishes, and usually quite steadily, until finally one may have to hunt through several fields before finding any

Both Depage and Carrel have constructed charts to describe this per cent of bacteria graphically. When the chart reads under the zero level for some time, say six days, and as the conditions lend themselves to it, the wound is "closed." Under this sterilization these wounds, after refreshing the skin edges, mobilizing flaps, etc., are sutured and heal very much as a fresh wound. Little is done in the way of refreshing wound surfaces excepting skin edges. A plug of obstructing granulations, if necessary, is shaved off.

These wounds heal in a manner that is simply indescribable. One has to see the behavior of these sutured wounds one's self to realize what happens. They heal with no more reaction from their appearance and manifestations than would be given by a wound which has been sutured on a cadaver—total absence of reaction, pain, swelling, redness, and even of infiltration around the wound edges. Dr. Dehelly, of Havre, tells me that he has closed 400 of these wounds with only 6 failures to obtain perfect primary union. Of these six mishaps, none was of any importance, and in some of these Dehelly said the fault was probably due to his failure to await complete sterilization, as evidenced by the bacterial count.

Carrel realizes that the method requires a good deal of personal attention, and is seeking to modify it by having an antiseptic which may be readily and continuously diffused all over the wound surface. He would like to use it very much as one does Beck's paste, which permeates every nook and cranny of a given cavity. For superficial surfaces he is using a chloralmine ointment. So far he has not been able to find a suitable medium to introduce into deep wounds.

During his recent visit last winter to New York, he told me that he was obtaining a full measure of success in the sterilization of old wounds, but the process of combating long-standing suppuration was very different from the prophylaxis of infection in recent wounds.

The Carrel method requires a proper appreciation of the principles of the treatment and an intimate knowledge of the technical details. As has been noted, the method consists of a series of steps, each one forming links in a chain, and the giving away of any one of these links destroys the usefulness of the whole structure. Much misconception exists about the method and it is supposed to be the application of a fluid containing hypochlorite of soda into wounds in some sort of fashion. These imperfect methods have been used, poor results have been obtained, and in some cases disasters. Consequently, the method has been condemned. It was most interesting to me to note last summer the divergence of views on the usefulness of the method. When I arrived at Paris before going to Compiegne, I found that the majority of the "high priests" of the surgical profession not only did not believe

in the method, but opposed it most acrimoniously. Investigation showed that the hostile party represented the party of ignorance, that is, I found that no one of the opponents with whom I discussed the matter had taken the trouble to go to Compiegne, sixty miles away, to study the method at its source, also, that some who had gone there had not realized the finer points of the technic or the necessity of scrupulously observing them.

I visited the clinic of a very excellent surgeon who enjoyed in Paris the reputation of having mastered the technic, and found (1) that he was not getting very good results, (2) that he was grossly violating some of the fundamental principles of the method. Commenting upon this to Carrel on my second visit to Compiegne, he smiled, and said, "The gentleman stayed here only an hour." Another surgeon who had employed the method, but not thoroughly and with consequent results, advised me not to stay any great time at Compiegne, as "It will only take you a couple of hours to get the whole thing."

On the other hand, every surgeon, particularly the Americans, who took the trouble to study the method with Carrel or Depage or Lyle became, without exception, profoundly convinced of the value of the method and its superiority to all procedures hitherto employed.

The particular pitfalls which I have observed are

1 The improper preparation of wounds, and failure to remove foreign bodies, necrotic material, etc

2 By failing to make free incisions and suitably placed incisions in which every portion of the Dakin fluid can come into direct contact with all portions of the wound

3 Failure to utilize tubes of proper calibre with suitable perforations as regards size, number, and situation, failure to place them so that every portion of the wound is properly moistened by the solution

4 Failure to introduce the fluid under the proper pressure, so that all the fluid shall run out as a spray and not trickle out of the first hole

5 Introducing the fluid under too much pressure. Excess of pressure is produced (Carrel and Dehelly) either by too great an elevation of the container or with small-sized incisions which prevent the easy outflow of the fluid between the wall of the wound and the tube (Fig 4<sup>1</sup>). This excess pressure is manifested by pain. If the introduction of the fluid at any time causes the patient pain it must be discontinued and the technical fault corrected.

In addition to pain too great a pressure may result in absorption of the fluid, with resulting hæmolysis and possibly death in a short time. It is quite possible that in certain wounds, as, for instance, an appendiceal abscess, in which a loop of gut presents, absorption may take place with disagreeable and perhaps fatal results if the condition is not recognized. On one occasion there was quickly produced a change in the patient's condition and transitory jaundice. So soon as these manifestations appeared treatment was discontinued and the patient recovered.

## THE CARREL METHOD OF TREATING WOUNDS

6 Failure to place the tubes so that the fluid runs down hill and not up hill, a very frequent source of error, as I have found (Fig. 2<sup>1</sup>).

7 Failure to locate the perforations in the tubes so that they are all contained within the wound, not allowing the fluid to run out on the skin

8 The use of too much fluid so that the wounds are drowned out and the fluid runs out on the skin with disastrous results

9 The use of packing and tampons in the wound, which prevent free access of the fluid to the bacteria (Fig. 1<sup>1</sup>)

10 Failure to realize the evanescent character of the hypochlorite and its dilution by wound secretions—in that the wounds are not moistened regularly every two hours, as prescribed

11 Failure to protect thoroughly the skin with a yellow vaseline smeared on gauze

12 Failure to use the correct solution, which is usually lacking in



FIG. 4—A, orifice too small—fluid is under pressure and cannot escape, B, proper sized orifice, permitting the free escape of fluid between wall of wound and tube

strength, there being only one-half per cent margin between efficiency and danger. In addition to the difficulty of getting perfectly correct proportions of the active chlorine, there is a very grave danger of over alkalinity, giving rise to burning and caustic action in the wound. The proper solution should *never* cause any pain. The appearance of pain should be a signal for the immediate discontinuance of the solution and an investigation of its accuracy.

As regards the results of the Carrel method in my service since its introduction last October, I have not been able to give it a very thorough trial, as I have lacked the more ideal cases, namely, the extreme degrees of trauma, especially compound fractures. I have had to limit it mostly to old suppurations. I can say in general that, while the method so applied has not worked any miracles, I feel, and I think I am supported by my colleagues, that we have been able to control suppuration more promptly than by any other method, and certainly the results of the bacterial examinations as recorded in our charts show in practically all instances an immediate and constant diminution of the bacteria.

The following are a series of consecutive cases depicting the very consistent drop in the bacterial count after institution of the Carrel method.

<sup>1</sup> Illustrations from Carrel and Dehelly



# CHARLES LANGDON GIBSON

OSTROMYELITIS OF FEMUR													
Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan
Day of Disease	1	2	3	4	5	6	7	8	9	10	11	12	13

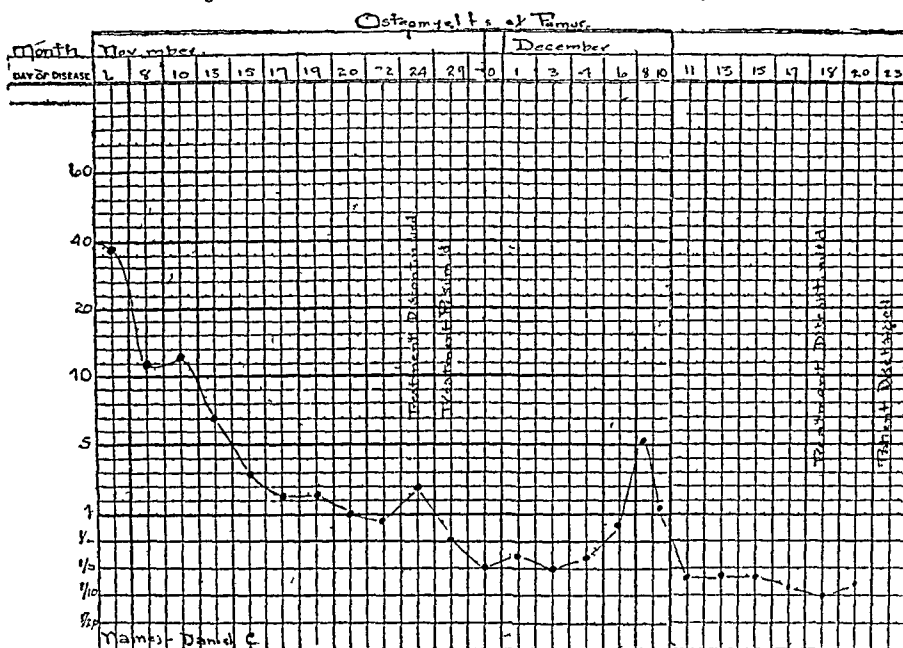
BACTERIAL CHART

FIG 5

OSTROMYELITIS OF FEMUR													
Month	November	December	January	February	March	April	May	June	July	August	September	October	November
Day of Disease	1	2	3	4	5	6	7	8	9	10	11	12	13

Bacterial Chart

FIG 6



Bacterial Chart

FIG 7

OSTROMYELITIS OF FEMUR													
Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan
Day of Disease	1	2	3	4	5	6	7	8	9	10	11	12	13

BACTERIAL CHART

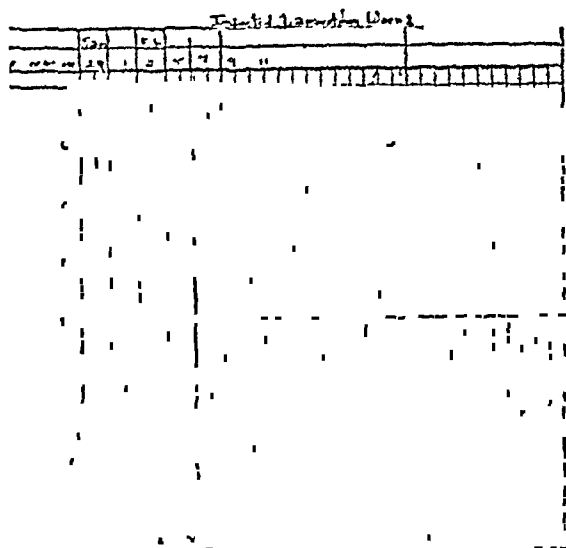
FIG 8

Abscess of Ovary													
Month	December	January	February	March	April	May	June	July	August	September	October	November	December
Day of Disease	1	2	3	4	5	6	7	8	9	10	11	12	13

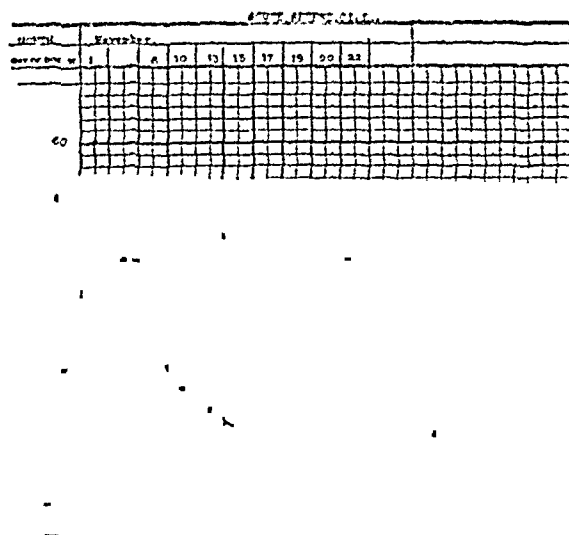
Bacterial Chart

FIG 9

## THE CARREL METHOD OF TREATING WOUNDS



Bacterial Chart  
FIG 10



FACTS CHART  
FIG II

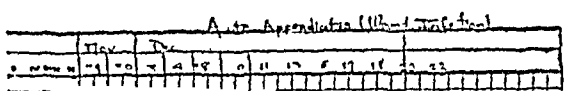


FIG 12

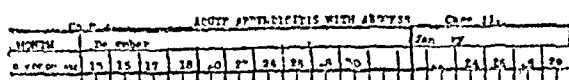
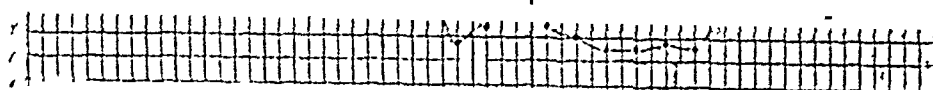
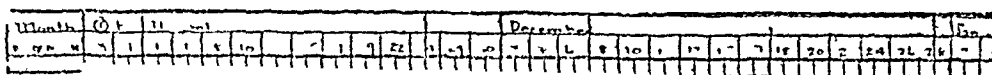


FIG 13



Bo. 4. 31 Cl 24

FIG 14

# OBSERVATIONS UPON SHOCK, WITH PARTICULAR REFERENCE TO THE CONDITION AS SEEN IN WAR SURGERY \*

BY EDWARD W ARCHIBALD, M D.

OF MONTREAL, CANADA

AND

CAPT W. S. McLEAN, C A.M.C.

DURING the past two years I (E A ) had the good fortune to spend eighteen months in service in France, four months of which were spent in a hospital close to the front

There are three kinds of service in the surgery of the present war (1) That of the hospitals close behind the front line, called by us casualty clearing stations, (2) that of the base hospitals in France, which are usually situated from thirty to sixty miles back, (3) that of the base hospitals in England In England one sees chronic surgery, at base in France one sees subacute and acute infections, and one goes continually shrapnel-hunting

But in the casualty clearing stations one sees three conditions in particular which are rarely or never seen at base far back They are abdominal wounds, the early and severe effects of "gassing," and finally shock, and shock is seen to an extent unparalleled in the experience of any surgeon at home The very frequency of it, and the terrible nature of it, were impressive, and, not less so, our inability to rescue such patients when the degree of shock was really serious

In what is here said to-day we do not pretend to bring forward anything particularly new, but we have thought that a general review of these cases of shock from the clinical side, with notes upon such methods of treatment as we are able to carry out, might be, particularly at this time, of interest to the members of the Association In addition, we would like to resume, briefly, the prevailing theories concerning shock, and to offer in the light of our clinical experience a few suggestions concerning these theories

In order to get a better comprehension of the conditions under which we did our work, let us relate, very shortly, the manner of evacuation of the wounded from the trenches to our casualty clearing station, situated some six to eight miles behind the front-line trenches The wounded soldier is usually carried without delay by the battalion stretcher bearers down a communicating trench to the dug-out of the battalion medical officer situated 400 or 500 yards back Here first aid is given, and then, if possible, the man is carried, still by stretcher bearers, for another 400 or 500 yards back to a point where a horse ambulance is waiting This can, of course, usually be done only at night, and there is sometimes a long delay while waiting for darkness The horse ambulance works back another mile or so to a point where it is safe for motor ambulances to wait Here another transfer takes place The motor ambulance then brings its load to field ambulance headquarters, or, if the wounds are serious, straight

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\* Read before the American Surgical Association, June 1, 1917

to the casualty clearing station, situated anywhere from five to ten miles behind the trenches, and usually at what is called rail-head. Here the wounded man finds his first good resting-place. The casualty clearing station has, on its establishment, accommodation for 250 stretchers, which is expandible up to 500 or more. During the past year and a half a limited number of proper hospital beds, from thirty to fifty, have also been provided by the army for the more serious cases, while the less serious ones are cleared the next day, or even the same day, by ambulance train down to base. It thus happened that we had under our care at any one time some 20 to 40 really bad cases. These were chiefly wounds of the brain, of the lung, and of the abdomen, together with bad compound fractures and multiple soft part wounds. Among all these shock was frequent.

Now, we would call your attention particularly to the fact which is not always appreciated, that the transport of the wounded from the trench to the casualty clearing station is frequently a most trying experience. The soldier, before he is hit, is often in a state of fatigue, and not seldom during the winter is he wet and cold into the bargain. Add to this the jolting of a stretcher journey of 1000 yards down a muddy, slippery, uneven communication trench, add to this the bumping of a horse ambulance along the roads of France such as they are at present well up toward the lines, add to this the transfer to the motor ambulance and a vibratory ride along the stone pavés of that country; add to this a couple of changes of dressing of a painful wound, add a certain loss of blood even in the best cases, add finally the effect of cold, and you get a composite set of circumstances for the reduction of the patient's resistance than which even Dr Crile could ask nothing better. The wonder to us was that we did not have more shock than we did. We may dismiss this aspect of the question by saying that an investigation of the cases showed quite clearly that a great many of the sufferers from shock gave a history of great exposure to cold and to fatigue during the time which elapsed from the receipt of their injury to their arrival in hospital. The influence of these factors was quite unmistakable. A French surgeon, M. Santy, in a very recent number of the *Lyon Chirurgical*, has called particular attention to this fact, and he was able to fill in a lacuna in our own experience. He had served both in the advanced dressing station and in what corresponds in their army to the casualty clearing station, and he says that, apart from those who die on the field, the occurrence of shock in the wounded soldier when seen soon after infliction of his wound, is extremely rare, but that the loss of even a strictly moderate amount of blood, together with the distresses of transport, will frequently push a wounded man, previously in good condition, into what he calls secondary shock, before his arrival at the hospital. [From what has been related to me by my friends serving with battalions and with advanced field ambulances I am quite sure that M. Santy is right. There is a tale told me, for instance, by a friend of mine of a man whom he saw wounded in the abdomen, actually running down the communication trench

to seek help, with the bulk of his small intestine hanging out in front of him That man was not, at first, in shock E A ]

One need spend but little time on the definition of shock Although the physiologists have for years past been trying to define shock for us, we clinicians are fairly well agreed upon the matter The picture was a sharp clinical one before physiology was The low-tension pulse, usually rapid, sometimes not, the shallow breathing, the pallor, sometimes going on into a light cyanosis, the lack of apparent suffering, the carelessness as to one's surroundings, the preservation of a clear though lethargic mind up to the very last—these things are all familiar to us, and these were the symptoms which, in our experience, were constantly present, whether the injury concerned the bones and soft parts or the abdomen Let us remark in passing that wounds of the chest and of the head very rarely, indeed, presented the symptoms of shock In going over the notes of our shock cases we find that practically all were wounds of the locomotor system or of the abdomen Of these we have for consideration 44 cases, of which there were 32 abdominal, 10 multiple wounds of the extremities, with or without compound fractures, and 2 chest cases We tried to keep decent records of our bad cases, particularly with regard to blood-pressure, but you will understand that these notes were not infrequently somewhat fragmentary on account of the press of work From the review of these observations we have picked out a few main facts meriting discussion

The very serious influence of fatigue, cold, and exposure as aids in the production of shock has already been referred to

Out of 25 cases, moderate and severe, in which reference is made to this point, there were only 2 in which the patient was said not to have suffered from it Roughly speaking, the degree of fatigue and exposure ran parallel with other serious symptoms of shock, although not always corresponding with fall in blood-pressure In practically all the recovery cases, while there was some fatigue, the patients were warm

*Temperature*—Guy Kinnaman in an article some years ago pointed out the serious effects of shock upon the temperature We found uniformly a serious fall His work was done on animals We have found in these clinical cases, and also in a small series of experiments (E A ), a confirmation of his general results Very frequently, if the patients were in marked shock, the clinical thermometer would not register, which meant that the temperature was somewhere below  $92^{\circ}$  Of 12 cases in which the temperature was low to this extent, death within a few hours took place in 9 There were only 3 recoveries, and of these 2 died later of gas gangrene

*Pulse and Blood-pressure*—If shock were marked, as judged by the general signs, blood-pressure was practically always below 75, and occasionally it could not be got at all Out of 17 cases with a blood-pressure below 75, only 3 rallied from shock, and these all died in two or three days from gas gangrene All the rest died within a few hours after admission or after operation The pulse was nearly always rapid—that is,

110 or over This probably has the same significance as in hemorrhage—a lack of sufficient blood to the ventricle in diastole Respiration was usually increased by six to twelve in a minute, *i e*, 24 to 32, and was always shallow

*Hemorrhage*—Hemorrhage, of course, was apt to complicate the picture It is well known that even a moderate loss of blood tends to predispose to or aggravate shock However, there was a considerable number of cases in which hemorrhage was either absent or very slight In these apathy and cyanosis as opposed to restlessness and blanching were marked Another striking difference lay in the effect of intravenous salt or of transfusion—helpful in hemorrhage, useless in severe shock

It was frequently necessary, on account of infection or bleeding, or, in abdominal cases, the presumed danger of peritonitis, to operate soon after admission in the middle of shock It can easily be imagined how serious such operations were In a general way, operations aggravated shock very definitely The old dictum that one should wait for the rally seemed to me to be absolutely confirmed by our experience

*Treatment*—Treatment under the conditions in which we worked was frequently difficult to carry out thoroughly We were often short-handed for the extreme demands which such cases made upon one's service However, we did manage to give a great deal of salt solution, we learned to prefer to give it intravenously rather than under the breast, in the latter case it was apt to be absorbed far too slowly to do any good Rectal salines were often given in addition Our experience confirmed what we all know, that the effect of intravenous salt is very transitory It rarely held up the blood-pressure in serious cases more than a couple of hours, often much less If the trouble were chiefly hemorrhage, results were much better A number of cases with a blood-pressure of 70 or over were saved by intravenous saline In a certain number we gave, following Hogan, a colloid solution of 25 grammes gelatin in a litre of saline Its effect lasted three or four times as long, nevertheless, in cases of bad shock, it did not avert the fatal outcome, in hemorrhage it was more effectual than the saline alone

Transfusion of blood was done in 3 cases, using the citrate method, 16 to 20 ounces being given Its effect was disappointing, while the color was improved and a slight rise of blood-pressure was got, it had no more permanent effect than the gelatin or salt In this the contrast with its truly life-saving action in cases of pure hemorrhage was most striking, after all, in shock we are not dealing with lack of blood alone, but with some complex mechanism by which blood is continuously withdrawn from the circulation, and to transfuse simply means that your transfused blood goes lost with the rest

The head-low position was, of course, always used, but without obvious influence save in light cases Pituitrin was freely employed, and always brought up the pulse to a certain extent, but this was often transitory, and, on the whole, we concluded that it had no real beneficial effect in bad shock In moderate shock it was of distinct value Theoretically it ought

to do good. The constriction of the peripheral arterioles now proved to be present in shock is very possibly a protective measure to compensate for lack of blood volume. It is, perhaps, indicated to increase this if possible, but adrenalin is contra-indicated because of its constricting action on liver capillaries, and we cannot afford to have an engorged liver obstructing free return from the splanchnic area, besides, adrenalin is too transitory.

In 2 cases we tried the opposite line of treatment, giving amyl nitrite in order to dilate the tight arteries of the periphery. There was a very fleeting improvement in the color of the skin, but no delay in the fatal exit. In another case we tried alternate rhythmic compression of the abdomen for an hour, but this had no good effect. In another case we rigged up a see-saw arrangement and kept up alternate head-low and horizontal positions for some time. We concluded that the permanently head-low position was better. Hot-water bottles were freely used of course. The majority died in spite of all our efforts.

*Interpretation of Blood-pressure Readings*—We used the auscultation method with the Tycos instrument.

Systolic blood-pressure is not so important in advanced shock as diastolic. Systolic may occasionally be up near 100, and diastolic be low, 20 to 40. This spells shock.

If an intravenous saline raises a low systolic, but fails to raise the diastolic, shock is still present and unrelieved, and the patient will die [This I have also seen in animals during the terminal stages. E. A.] The systolic peak under such circumstances does not mean much.

If the sharp click of the systolic is weak or distant throughout, there is danger.

If the systolic sound is first heard only during expiration, and becomes continuous only some ten to twenty millimetres lower, such cases are always in shock and blood-pressure is low. They frequently die.

A man with the ordinary symptoms of shock, whose systolic blood-pressure is 65 or below, rarely recovers. One whose blood-pressure is low from hemorrhage alone will frequently recover. Salt solution does no good in the first, but does good in the second.

Ordinary hemorrhage, unaccompanied by fatigue, or cold, does not reduce pressure materially. A large amount of blood must be lost to lower it to 75. Often we would find the abdomen full of blood, by measurement 45 to 55 ounces, and blood-pressure would be normal if shock were absent.

*The Cause of Shock*<sup>1</sup>—Space fails me to resume all the work that has recently been done. I must content myself with making categorical statements. Assuming that shock is due to circulatory failure, we have to ask ourselves two questions: (1) At what point of the circulation is the failure primary? (2) What is the cause of the failure at that point?

Let us briefly consider all the systems concerned.

1. The heart is strong enough.

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<sup>1</sup> The rest of the paper is by E. A.

## SHOCK AS SEEN IN WAR SURGERY

- 2 The vasomotor centre is strong enough
3. The arterial tree is strong enough
4. The peripheral capillaries are empty (blanched) or contain half-stagnating blood (cyanosed).

5 The peripheral veins show low blood-pressure and are comparatively empty, as shown by the difficulty in finding veins in the arm for infusion, and in animals by direct observation (*e g*, the smallness of femoral vein in experiment of May 14, 1917, when exposed for injection of gum solution)

6 The splanchnic veins are sometimes moderately full, sometimes not. This is particularly true of animals, in which marked engorgement of this area is not present unless shock has been produced by manipulation of the viscera

7 The tissues of the dog's intestine become markedly œdematous when shock is produced by manipulation of the bowel, also, though to a less extent, when produced by mere exposure of the bowel

8 The lungs do not give out, though they contribute by shallow inspiration and prolonged expiration, with consequent lack of suction, to the diminution in the return of venous blood to the heart

9 The brain is clear to the end

10. The muscular system is relaxed and contributes by lack of work to stagnation of venous blood

11 The adrenals, according to Bedford, are not exhausted, but, on the contrary, deliver an increased amount of secretion during profound shock, right to the end

Now as to blood-pressure. While a low blood-pressure is one of the most constant signs of shock, it is not the essential thing, let alone the cause of it. We have focussed our attention far too much on blood-pressure, so much so as unconsciously to have come to regard it as almost causal.

To raise peripheral blood-pressure accomplishes nothing save a mechanical effect. A raised blood-pressure is not life. In bad shock, the saline runs into the tissues from the blood, and you are left as poor as before. Even blood, let alone Hogan's gelatin solution or Bayliss's gum acacia solution, will do but little more, it, too, disappears into the tissues. Dolley kept up blood-pressure in shocked dogs to near normal for two or three hours by repeated transfusions of blood, but at the end of that time blood-pressure fell rapidly, and then the dogs died of shock in ten minutes. The fundamental trouble was not removed. Janeway and Ewing bled two dogs into one shocked dog. The latter accommodated all this blood and continued in shock, while the two donors were left exsanguinated.

What the nature of the cause of this loss of fluid from blood to tissues is can as yet only be guessed. I do not believe it is hyperpnœa from *pain* and consequent general acapnia as Henderson suggests. Our patients all received  $\frac{1}{2}$  grain of morphine at the Field Ambulance, and it did not prevent shock. It may be a local acapnia when bowel is long exposed, but primarily it is more probably in the nature of an inhibition by which capil-



lary tone is lost and the balance of the local chemical changes between blood and tissue or cell fluids is upset, perhaps chemically, perhaps by stagnation and insufficient oxidation. I imagine cold, fatigue, and wet may assist such an upset. Death by freezing, for instance, is one form of shock, and shock may be brought on in animals by cooling the blood, as Mann showed. But on top of that comes severe local injury, loss of blood, wounds of the mesentery—all combined may let loose reflex inhibition.

Recent English work has demonstrated in shock a serious loss of plasma into the tissues, with consequent rise in the hæmoglobin count and the viscosity of the blood in the vessels. In shock produced by histamin, Dale and Laidlaw showed that one-half the plasma had disappeared into the tissues. The same is true in cholera shock. Captain Marshall (personal communication) has found an increase of 20 per cent in the hæmoglobin count in shock cases at a Casualty Clearing Station. On the other hand, obvious œdema at postmortem is not always, or even often, seen unless large amounts of saline have been infused. I suspect it may be in traumatic shock what Krehl suggested was the case in fever, that the extra water is retained chiefly in the cells themselves and not in the tissue spaces.

By exclusion, therefore, it appears to me that the trouble begins in the vast capillary system, that enormous area of marshy ground in which fluid has such a chance to stagnate. We know, with fair certainty now, from the work of Cotton, Slack, and Lewis, that the capillaries possess active contractility. Dale and Laidlaw believe that in shock produced by histamin the tone of the capillaries is lost and blood stagnates. For the present I accept this as the point of primary failure in traumatic shock. Pallor, followed in bad cases by cyanosis, is an outstanding feature in our observations. The veins no longer receive enough blood. If they did we could overcome shock by gravity and by compression, which we usually fail to do. Consequently, the failure in the venopressor mechanism (Y. Henderson) is a secondary effect, likewise the gradual failure of the heart and of the coronary supply, all of which assist in the establishment of a vicious circle. The capillary failure leads to insufficient oxidation, which results in asphyxial acidosis. "The acid substances thus formed cause the proteins of the tissue to imbibe water from the blood in much the same manner that fibrin swells in dilute acids. Hence the fatally rapid transudation of fluid from the blood-vessels" (Henderson).

This work suggests that hypertonic salt solution at twice decinormal strength would be of some promise. Its chief effect would naturally be to call back into the blood the plasma lost to the tissues. But very possibly it also acts by restoring capillary tone. I am told that some encouraging results have recently been obtained at the front with it. I have no clinical experience, but in one of my animals, reduced to deep shock by abdominal exposure, the tongue, up to then quite cyanosed, recovered quickly with hypertonic salt a normal pinkish tinge, obviously a local effect on capillaries, inasmuch as blood-pressure previously at 35 was raised only to 50.

# INJECTION OF THE GASSERIAN GANGLION FOR NEURALGIA OF THE FIFTH CRANIAL NERVE\*

By GEORGE TULLY VAUGHAN, M D.

OF WASHINGTON

CUTTING with or without resection of the affected nerves for neuralgia is a comparatively old method of treatment, as it was used by Astley Cooper, Velpeau and the elder Warren, but the method by injection of destructive substances into the nerve seems seldom to have been used previous to 1884, when Neubeig reported cases treated by injection of osmic acid

It seems that Wright in 1907 was the first to inject the Gasserian ganglion, exposing the ganglion as if for removal and then injecting it with osmic acid, and later Rasoumosky used alcohol in the same manner

Schlosser, Sicaïd, Ostwald, Hartel, Wright, Harris and Camp by degrees worked out the methods now used for injecting the ganglion through the foramen ovale from the skin

According to Byrnes, Ostwald and Sicaïd, in 1906, suggested the subcutaneous way of injecting the ganglion Pussep, in 1911, made the first though unsuccessful attempt by this method—at any rate he was so unfavorably impressed by the immediate effects on the patient—vomiting, headache, slow pulse and cyanosis—that he condemned the operation as unjustifiable Four months later Taptas of Constantinople seems to have made accidentally the first successful injection into the ganglion while trying to inject the third branch Wilfred Harris of England, working along the same lines and about the same time, improved the technic by inserting the needle through the lower part of the sigmoid notch, and in 1912 published seven cases The operation is not very difficult, it is pretty sure to give relief for a time, perhaps permanently, and should be tried in all cases before doing a gasserectomy

There may be some question as to whether or not it should be preferred to the Frazier-Spiller operation, as the latter operation preserves the motor functions of the nerve Experience shows that injection is the safest operation—certainly as to life and probably also as to the bad effects produced on the eye

Weidler says that in a series of over 300 cases of alcohol injections, in only one was there serious keratitis, whereas in seventy cases of gasserectomy a number of cases of keratitis occurred, and in four cases enucleation of the eye was necessary This may not be a fair comparison as in few of these injections was the ganglion attacked However, no surgeon would agree with the statement that injection of the ganglion is free from danger, and yet I know of only one death reported from it—that of Hartel from septic meningitis, probably due to an error of technic The danger of

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\* Read before the American Surgical Association, May 31, 1917

injuring some of the important structures that are so intimately related to the ganglion either by needle puncture or by the action of the alcohol when one is feeling his way in the dark, is certainly great, but experience shows that if such injuries are inflicted, they do not seriously injure the patient. The structures which are most liable to injury are the internal maxillary and middle meningeal vessels, the cavernous sinus, the third, fourth, and sixth nerves, the carotid artery and the under surface of the temporal lobe of the brain. The injury may be purely mechanical from punctures, laceration, or contusions, or it may be chemical from the action of the alcohol on the tissues, or it may even be the result of infection.

My cases are reported chiefly because it is only by observing the results in large numbers that we can reach a reliable conclusion as to the value of any remedy.

CASE I—Three injections. Woman, aged forty, with history of tic douloureux for fifteen years on right side and a slightly shorter time on the left side. All three branches affected on both sides, but especially the second. Ten years before Dr. Finney had removed the right infra-orbital nerve with only partial temporary relief. She is an intelligent educated woman and knew something about the surgical treatment of her trouble and came to me for the purpose of having both Gasserian ganglions removed—her suffering was so great. She was persuaded to try the method of injection first. With the patient in a half-reclining position under local anæsthesia, with a cork between the teeth in order to lower the sigmoid notch about half an inch, the graduated needle with blunt point was inserted on a line drawn from the lower part of the mastoid process to the lower part of the malar bone and carried inward through the lower part of the sigmoid notch slightly backward and slightly upward until the point entered the foramen ovale, indicated by the limitation in the lateral motion of the point by depth— $4\frac{1}{2}$  cm—and in this case by the escape of a few drops of cerebrospinal fluid. The needle was pushed a little further till the total distance from the skin was 5 cm. The syringe was attached and 1 c c of novacaine with adrenaline was injected. In five minutes there was no conjunctival reflex on that side and 1 c c of alcohol was then injected and the needle was withdrawn.

The same procedure was then carried out on the other side. In fifteen minutes there was anæsthesia of the entire face.

Next day there was a return of pain on the right side in the region of distribution of the first and second branches, and, as this continued, another injection of the right ganglion was made one week after the first—exactly the same technic. This time there was wide dilatation of the right pupil which lasted two or three days. Complete relief followed this injection. Patient was cautioned to take care of the eyes on account of the danger of irritation from the lack of normal protective sensation.

Examined more than a year later, the conjunctivæ were a little con-

## INJECTION OF THE GASSERIAN GANGLION

gested in both eyes, no trouble with the cornea. There was analgesia of the entire face though pressure could be felt. Patient had had no pain and expressed herself as well pleased with the result.

CASE II—One injection. Woman, aged thirty-four, highly nervous, had suffered with pain in the right eye, ear, temporal region and side of the face. Has taken large doses of morphine for the pain. No disease of eye, ear or brain could be detected.

Right ganglion was injected. Temporary ptosis of upper lid and dilatation of the pupil followed and there was analgesia of that side of the face, but the patient still complained of pain but less in degree. The pain soon died off, but some ptosis and dilatation of the pupil remained when she was last heard from—about three months after the operation.

CASE III—Man, aged fifty-six, with right-sided neuralgia of 5th nerve for which the infra-orbital had been removed ten years ago, giving relief to the middle of his face, but he continued to suffer in regions supplied by the first and third branches and came to me for removal of the ganglion. It was decided to try injection of the ganglion first. An attempt was made in the usual way but failed to enter the foramen ovale and only the third branch was anæsthetized. Five days later the attempt was again made, entering the needle half a cm. lower than before, when it was guided into the foramen with little trouble, the total depth being 6 cm. from the skin. One c.c. of 95 p.c. alcohol was injected. This gave complete relief, but it is yet too early to predict anything as to its permanence.

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# EMPHYEMA OF THE THORAX<sup>1</sup>

REPORT OF ONE HUNDRED CASES TREATED IN THE SURGICAL SERVICE OF THE WRITER,  
AT MT SINAI HOSPITAL<sup>1</sup>

By HOWARD LILIENTHAL, M D

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BEFORE this Association, in 1915, the writer presented a paper describing his method of procedure in empyema of the thorax

The keynote of the surgical treatment was full and complete exploration through a widely spread, long intercostal incision without resection of the ribs. In this paper it was distinctly stated that while standing for the principle of free exploration this operation might be performed as a second stage following the relief of cyanosis, dyspnoea or other threatening symptoms of intrathoracic pressure by a minor intercostal incision with tube drainage. It is to be clearly understood that while no single procedure is suitable in all cases our aim must be to secure a final result with no impairment of chest capacity.

Having now had the opportunity of observing one hundred cases treated in my service at Mt Sinai Hospital, from March 25, 1914, to March 25, 1917, a period of three years, the time is considered ripe for reporting this experience and the conclusions which have been reached.<sup>1</sup>

To begin at the end I may say at once that with increasing familiarity the treatment of this condition as previously outlined has impressed itself more and more favorably upon me.<sup>2</sup> Moreover, other surgeons who have been present at these operations have expressed themselves as convinced and a number of them have adopted the method.

All patients suffering from empyema of the thorax and not previously treated surgically were operated upon regardless of the prognosis and regardless of the source of the pus.<sup>3</sup> No patient was refused because he was believed to be moribund, and this can be well illustrated by noting that one death occurred before the anæsthetic was administered and before an incision had been made, the end coming during the preparation on the operating table. This case, naturally, is not included in our list because no operation was performed. One patient with pyæmia, perforated metastatic lung abscess and suppurating osteomyelitis of the bones about the knee-joint died following an amputation of the thigh. This case is counted in our list. Two fatal cases of pyæmic

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\* Read before the American Surgical Association, June 1, 1917

<sup>1</sup> Since the report in 1915 two papers on this subject have emanated from this Service, the first by Lilienthal and Ware, "Recent Progress in the Operative Treatment of Empyema of the Thorax," *Med Rec.*, July 15, 1915, second, "The Trend of Surgery in Empyema of Thorax," by Martin W Ware, *ANN SURG.*, March, 1917

<sup>2</sup> The operations in the one hundred cases were performed by the writer, by Dr Joseph Wiener, and by Dr Martin W Ware. A few cases were operated on by the House Surgeon under supervision.

<sup>3</sup> Those operated upon elsewhere and coming to us with thoracic wounds are not referred to in this paper.

## EMPHYEMA OF THE THORAX

abscesses of the liver with perforation into the chest are also included. One case of tuberculosis of the lung with perforating bronchiectasis still further swells our mortality rate, and all of these cases fall under the group of those which were operated upon by the procedure which I have taken the liberty of denominating Major Intercostal Thoracotomy.

Deducting these, instead of 100 cases with 23 deaths we would have 95 cases with 18 deaths, or 18.9 per cent mortality instead of the 23 per cent which my table shows—for I am not in sympathy with the sport of juggling with statistics.

It will be noted that the one hundred patients whose cases we tabulate represent 38 minor thoracotomies, many of them preceded by minor thoracotomy, 44 major thoracotomies with 18.4 per cent mortality, death rate 27.2 per cent.<sup>4</sup> Resection of ribs with their periosteum and gauze packing in encapsulated empyema treated as if it were an abscess, 7 cases with no deaths. Resection and drainage by the old method 7 cases with 1 death, or 16.6 per cent. This is in reality one form of minor thoracotomy.

The 100 patients were divided between children and adults, 64 under twelve years of age, 36 over twelve years old.

Male patients predominated over females at the rate of about 2 to 1, or, in the last two years 25 females to 51 males. Counting as we have all cases of empyema primarily operated upon and counting the deaths, no matter from what cause, the mortality shows a 5 per cent improvement over the ten years with 299 patients reported recently from all the Surgical Services at Mt Sinai Hospital.<sup>5</sup>

The patients who recovered remained in the hospital an average of about 37 days, a gain of one week over past records.

But now we come to a matter of the greatest importance where a most striking improvement is demonstrated. In former years collapsing thoracoplasties were performed in a large percentage of cases, probably at a moderate estimate in the neighborhood of 15 per cent. During the period covered by my table in all the cases operated upon in my service at Mt Sinai Hospital, without the slightest attempt at selection, there has not been a single thoracoplastic collapse operation. There have been a number of revisions, secondary and even tertiary, but eventually all the patients referred to in the attached table not in the mortality list went home with symmetrical chests and fully expanded lungs. I believe that if nothing else had been accomplished by the work of the past three years this alone would entitle it to respectful consideration.

We have not taken unnecessary risk in selecting major thoracotomy as the method of choice. Whenever a patient's condition on admission to the Hospital was considered critical the relief of minor thoracotomy was given, and, in a few days to two or three weeks later, if it became

<sup>4</sup> This extraordinary mortality does not represent the dangers of Major Thoracotomy, for the reasons just given.

<sup>5</sup> Wilensky, Surg, Gyn and Obst, May, 1915.

evident that something more had to be done, the radical operation was undertaken

In the past two years one-third of our major thoracotomy cases were performed in two stages

We try to avoid exploratory puncture of the thorax until just before the operation, depending on the clinical history, the physical signs, and above all, on the X-ray plate in making the provisional diagnosis

Also, during convalescence, repeated observation with the aid of the X-ray, especially with stereoscopic plates, often determined the necessity for further operation. Indeed, no method surpasses roentgenography in deciding the form of treatment during the progress of the empyema, but roentgenography, valuable as it is, must be carefully checked up with the interpretation of the clinical phenomena

X-ray examination has occasionally been the means of preventing operation when the needle has drawn pus from the chest

CASE I—A boy eleven, George W, was admitted with a history of pneumonia with continued fever long after the crisis should have occurred. The needle inserted by a physician not connected with the hospital had withdrawn pus and the case came to us for operation. The physical signs might have been taken for those of pyothorax, but the roentgenogram indicated consolidation (Fig 1). In spite of the temperature of  $104^{\circ}$ , the cyanosis and distress, we delayed on the evidence of the X-ray alone, and we were rewarded by a well-marked crisis within 20 hours, the temperature reaching normal and convalescence proceeding uneventfully. The pus may have been a few drops of cellular fluid in the pleural sac or it may have been exudate from the lung itself

CASE II—A young woman, Bella G, with septic manifestations accompanied by tremendous oscillations of temperature, with pain and swelling of the larger articulations and with signs of fluid in the right chest, was seen by me in consultation. I was told that a few cubic centimetres of pus had been obtained by aspiration of the right chest. The X-ray picture made subsequently showed no evidence of fluid in the thorax and I advised against operation. A few days later I was informed that pus had been aspirated from the left chest as well. The patient was taken to the operating room and I withdrew about 2 c c of pus from the right side. The respiration, however, was not embarrassed as I thought it should have been in the presence of empyema in both thoracic cavities and I did not operate but ordered a second X-ray which, like the first, failed to show the expected opacity. At the present writing, three months after the first diagnosis of empyema, the thorax is perfectly clear, and the respirations are normal though the septic manifestations continue in spite of a general improvement<sup>6</sup>

CASE III—The patient, J L, was a child of three, the son of a physician. He was referred to me by Dr Koplik with the suspicion of empyema following pneumonia. The radiogram disclosed a shadow limited to the left lower lobe (Fig 2), and on the strength

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<sup>6</sup>July 25, 1917. This patient has completely recovered without operation



FIG 1 —Case I, G W, pneumonia diagnosed as empyema and punctured for diagnosis by another physician. Note the small localized pneumothorax in the right lower chest, resulting from the admission of air probably through the needle. Patient recovered without operation.



FIG 2 —Left lower lobe suppurative pneumonia. No empyema was present though the needle drew pus.





## EMPHYEMA OF THE THORAX

of this I deferred aspiration. A few days later, the septic temperature continuing and the child's father being importunate, I inserted a needle and withdrew a few drops of thick pus. The chest was then opened in local anæsthesia and the lower lobe found indurated, dusky in color and adherent to the chest wall, the free pleural cavity containing no fluid and appearing uninfected. Two abscesses, each containing about 5 c c of thick pus, were evacuated after being located in the lower pulmonary lobe with the needle through the wound and under the guidance of sight. The cavities were packed, the wound drained and the patient recovered. This case is by no means unique, though it is rare.

These three histories are here recorded not as cases of empyema but merely to illustrate methods of eliminative diagnosis.

There were three cases of double empyema. All the patients were critically ill and all were young male children. There were two recoveries and one death. The two patients who recovered were B K, three and

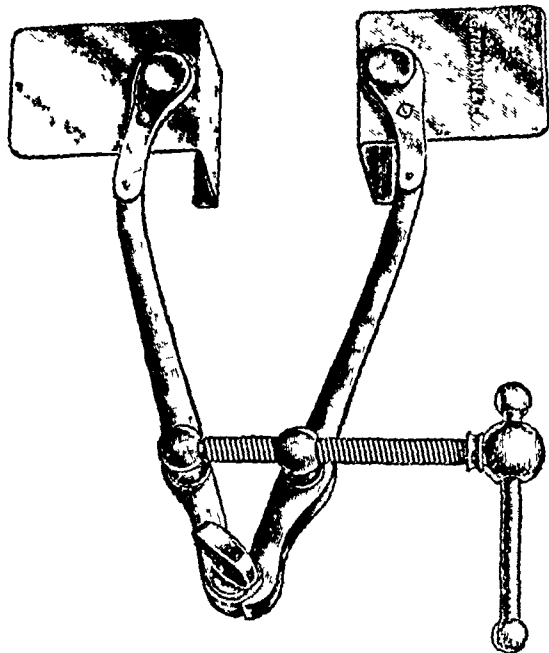


FIG 3 —Author's rib spreading retractor. Two sets of blades.

one-third years old, and S B, two and three-fourths years old. In one the chests were opened by minor thoracotomy two days apart and in the other by minor thoracotomy eighteen days apart. The fatal case was that of H K, four and one-half years old. Here both chests were opened simultaneously on May 2, 1916. On June 13 it became necessary to resect the seventh and eighth ribs on the left side for drainage. He died septic four days later.

Minor thoracotomy in these young children is a mere puncture in local anæsthesia, often performed by inserting a trocar and cannula through a tiny skin incision, withdrawing the trocar and threading a tube through the cannula which being in turn removed leaves the tube draining the chest. The outer end is left long and with a suitable connection is led down beneath the surface of a weak lysol solution in a vessel beside the bed.

The operation of major thoracotomy has been fully described and illustrated<sup>7</sup> so repetition here is unnecessary. It is rarely accompanied by important bleeding and post-operative shock has thus far been easily combatted by means of morphine or codeine. We have had but one death within twenty-four hours after the operation, an old man who was almost moribund at the time of the thoracotomy and who developed hemiplegia a few hours later.

The writer believes that many surgeons have been deterred from giving this method a trial because it requires a rib-spreading retractor, and during the past two and a half years it has been impossible to secure this instrument on account of the war. And it is true that without a powerful rib retractor the operation of intercostal major thoracotomy cannot be correctly done. As soon as it becomes necessary to make section of the ribs in order to gain the room for thorough exploration the operation increases in danger and the post-operative troubles multiply. Of all the foreign rib spreaders that of De Quervain is the simplest and the best, but even this well-made instrument is subject to annoying disorders of mechanism. Also, the blades are large for work in the case of children. The writer, therefore, has devised a simple retractor (Fig 3) which is fully as powerful as any while its tendency to get out of order is reduced to the minimum. There are large and small blades which are interchangeable and the instrument can be quickly and easily taken apart. It is manufactured by Tiemann.

[After the reading of this paper the operation of major intercostal thoracotomy with lung mobilization was illustrated by a motion picture. This picture also showed the patient eleven days after operation. He was able to walk about and move his arms freely. Figs 4, 5, and 6 are taken from this film by permission of the Clinical Film Co., Inc., who hold the copyright.]

	Minor thoracotomy		Major thoracotomy		Resection for encapsulated empyema		Resection and drainage, old method (Minor thoracotomy)		Miscellaneous	
	Children	Adults	Children	Adults	Children	Adults	Children	Adults	Children	Adults
Number	31	7	21	23	6	1	6	1	0	4
Dead	6	1	4	8	0	0	1	0	0	3
Ages of those who died	1/3, 1 1/2, 2, 3, 4, 4 1/2	62	1/3, 2, 3 1/2, 4	16, 24, 25, 35, 40, 43, 52, 55			1 1/2			25, 27, 33
Per cent mortality	19.3%	14.3%	19%	34.7%	0	0				
Total	38		44		7					
Mortality rate	18.4 per cent		27.2 per cent		0					

Total number of cases of empyema of all varieties which were operated upon primarily in Dr. Lilienthal's service in Mt. Sinai Hospital, March 25, 1914 to March 25, 1917, regardless of the source of the intrapleural pus  
 Total number of deaths from whatever cause  
 Percentage of mortality  
 Children under 12 years  
 Adults

100  
 23  
 23 per cent  
 64  
 36

<sup>7</sup> See reference on page 291



FIG 4—Rib spreader in place. The light colored mass in the lower left part of the incision is the contracted lower lobe covered by exudate. The mass in the depths toward the upper right part of the wound is the upper pulmonary lobe which is only a little contracted.



FIG 5—Removing lymph coagulum with forceps.



FIG 6—Note expansion of lower lobe by comparing with Figs 4 and 5.



# DILATATION OF THE HEART, WITH ACUTE MYOCARDITIS, FOLLOWING ABDOMINAL OPERATIONS<sup>\*</sup>

By EDGAR A. VANDER VEER, M. D.

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Not infrequently in consultation with fellow practitioners in medicine, and perhaps bearing upon some particular proposed operation, we are told of the "tobacco" heart—the heart carrying a high blood pressure, the heart associated with chronic alcoholism, the hypertrophied heart and the irritable or fatty heart—the heart believed to be undergoing fatty degeneration, and which may be attributed to some infective disease through which the patient has recently passed. Also we are told by the family physician, in the argument presented, that he had considered the case not a proper one for surgical intervention. Habits and environment may be brought into consideration. Conditions present in other organs of the body are discussed. Valvular lesions are so thoroughly understood as to be well recognized as factors of danger in surgical intervention. This clearness of diagnosis, however, teaches the surgeon the care to be exercised in his operative treatment. His favorable prognosis occasionally will bring under consideration one of the conditions that may be presented later, and of which I desire to speak, namely, myocardial conditions, or, as it is generally referred to, myocarditis and acute dilatation of the heart.

To have completed a successful operation, and when all is apparently going well with the patient, to be called, perhaps as soon as thirty-six hours or any time within two weeks, to the bedside of this surgical case, and to note the train of symptoms plainly found to be myocardial, that is, heart area greatly increased, rapid pulse-rate and intermittent, apex beat weak, diffused, patient restless and presenting an unexplained state of anxiety, does not complain of any acute pain—with these conditions one is brought into that intense atmosphere of anxiety, of which our older surgeons used to speak in connection with immediate or secondary post-operative hemorrhage. But much more helpless are we surgeons of to-day. Referring especially to abdominal surgery, the success of to-day is so great that when we meet a sudden, unexpected death, it becomes our duty to study even more carefully the causes producing such a result.

Are there in some cases foci of infection resulting from the operation which are aroused to activity and attack the heart muscle as a line of preference?

My wish in this short paper is to report a few cases very distressing to me in my surgical work. A series of abdominal operations occurring in my service at the Albany Hospital, which were followed by acute myocarditis, first attracted my attention to this coincidence. Since then I have

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<sup>\*</sup>Read before the American Surgical Association, June 2, 1917

observed that in gall-bladder or appendix infection which has existed for any length of time, even though no apparent heart symptoms appeared before operation, they did in a certain percentage appear soon after in a greater or lesser degree. I have not observed this phenomenon following other abdominal operations, but I see no reason why it might not occur.

In Billings' work on Focal Infections, he quotes some experiments conducted by Dr. Rosenow, in which the relation of certain strains of bacteria found in the gall-bladder produced an acute myocarditis when these bacteria were injected into an animal. Outside of the reports of these experiments, and a paper by Dr. Robert H. Babcock, of Chicago, published in the *Journal of the American Medical Association*, of July 12, 1909, and later in the *Southern California Practitioner* for March, 1911, entitled "The Effects of Chronic Cholecystitis on the Heart," I have been unable to find anything in the literature upon the subject, and absolutely nothing from a surgical standpoint. In his paper, Dr. Babcock cites a series of myocarditis which were associated with chronic gall-bladder disease, and which were greatly benefited by operation upon the gall-bladder.

I append here a few histories in which operation upon the gall-bladder or appendix was followed by symptoms of acute myocarditis and acute dilatation of the heart.

CASE I —J. G., age sixty-four, lawyer, always in good health, operated upon for an acute gangrenous appendix, symptoms extending over a period of forty-eight hours. Before operation systolic blood pressure was 160 mm., diastolic 110 mm. Pulse full and regular, sixty to the minute. Anæsthesia and operation uneventful. No unfavorable symptoms for the first sixty hours after operation, then gradual increase in pulse-rate, from sixty to 110, respirations twenty-four per minute, heart sounds rather distant—many of the clinical symptoms of an acute myocarditis. Treatment consisted of low enemas and the administration of digitalin. Patient gradually recovered, the wound healed promptly, showing no signs of any infection whatever. Three months after the operation, heart had returned to its normal condition, and pulse regular. Complete convalescence established.

CASE II —Mrs. S., age fifty-three, widow, housewife. History of gall-bladder trouble for several years. Operation for cholelithiasis, several gall-stones removed. Anæsthesia well borne, and field of operation did not present any unusual complications. For the first thirty hours no unfavorable conditions, then all the symptoms of acute myocarditis developed, and the patient died twelve hours later. This patient presented a severe example of mental depression, saying that she did not believe she would recover from an operation. Such a result is most distressing to the operator and to the friends. In cases of malignancy, and where we have serious lesions with which to deal, we are prepared somewhat for a percentage of mortality, but an unexpected death is not easily forgotten. Unfortunately, such a result militates against securing an autopsy, this being the case here, her friends were overwhelmed by the result.

## MYOCARDITIS FOLLOWING ABDOMINAL OPERATIONS

CASE III —Mrs A A, age sixty-six, married, housewife History of gall-bladder trouble extending over several years Operation for cholelithiasis and cholecystitis Anæsthetic presented no unpleasant complications, and operation completed without embarrassment Gallstones removed and gall-bladder drained Heart action normal Patient progressed nicely for first fifty hours, when symptoms of acute myocarditis with dilatation of the heart presented Slow and rather stormy convalescence

CASE IV —Mrs P B., age sixty-two, married, housewife Operation for chronic cholecystitis and cholelithiasis and acute appendicitis No complications Ether and operation uneventful Heart normal Case progressed normally for sixty-five hours, when quite unexpectedly dilatation of the heart, with symptoms of acute myocarditis, appeared Prolonged convalescence

CASE V.—J M, age sixty-two, blacksmith No clinical evidence of myocardial trouble Operation for cholelithiasis Etherization and operation well borne Case progressed favorably for twenty hours, when symptoms of acute myocarditis, with dilatation, presented Patient responded rather tardily to treatment, but finally recovered

CASE VI —Mrs R M, age sixty-four, widow, housewife Typical symptoms of cholecystitis extending over a period of years Physical examination, heart and lungs normal Operation draining of the gall-bladder and appendectomy Did nicely for fifty-five hours, when symptoms of acute myocarditis intervened, and convalescence was greatly prolonged

An analysis of these cases presents the fact that physical examination of the heart before operation revealed no symptoms of myocardial trouble Etherization in every case was without unfavorable symptoms All recovered from the immediate shock of the operation and were well on their way to recovery when the symptoms of acute myocarditis appeared None of the cases gave a history of any heart lesion None of the wounds, blood examination, or symptoms gave any indication of septic infection Apparently the operation excited germs which were in the gall-bladder or appendix, and they secondarily invaded the heart muscle, in keeping with the views expressed by Rosenow

With one exception, all these cases were elderly and had suffered several years with gall-bladder disease, so that it is very possible this condition of acute myocarditis might have been the result of the long period of suffering augmented by the shock of the operation However, in cases of other abdominal conditions I have not observed this post-operative complication so marked Therefore, is it reasonable to assume that the acute myocardial symptoms in these cases were due to a secondary infection?

Pathological study of these cases, as presented in the laboratory reports, is interesting In these, as well as others, we have brought to our attention many etiological factors only recently understood, and all emphasizing the benefit resulting from the laboratory research work I am of the impression, particularly in our cases of appendix and gall-bladder operations, that



a careful and thorough examination of the secretions should be made promptly after operation, and a record preserved, to be of aid in treatment should symptoms of myocardial involvement present

In these cases of cholecystitis the gall-bladder was drained only. What the effect might have been if a cholecystectomy had been done I, of course, cannot say with any degree of certainty, and it involves the question of cholecystectomy versus cholecystotomy. In a few other cases, not here reported, where the appendix was removed, acute myocarditis followed in like manner.

Would it not be advisable to develop a stock vaccine or antitoxin from the gall-bladder or other abdominal organs involved, and use it in cases of this sort? At the present time I am outlining a series of experiments to be conducted at the Bender Hygienic Laboratory, along these lines, with the view of developing a vaccine or antitoxin for this distressing complication. When we feel quite sure that acute symptoms are liable to follow surgical intervention, possibly we might vaccinate the patient before operation. This would be in elderly cases with long-standing gall-bladder or appendix conditions.

As mentioned above, in Billings' work on Focal Infections, he speaks of a strain of streptococci, isolated by Rosenow, which inhabit the gall-bladder and secondarily cause acute myocarditis, also of strains of streptococci in other organs and tissues of the body. Therefore, why is it not probable, in these chronic gall-bladder and appendix cases, that doing an operation excites these peculiar colonies of streptococci, starts them on their journey and causes acute myocarditis? We all know that the diseased tonsil is occasionally followed by acute secondary infections in other parts of the body. So in the same way operations upon the diseased gall-bladder and appendix, when the right strain of bacteria is encountered, cause acute myocarditis. Just how this condition can be recognized and prophylactic measures adopted, I am unable to say. Undoubtedly, cultures from the bile might be made in every case of cholecystitis, appendicitis or other abdominal disease, and held in case any myocardial symptoms appear.

My impression is that acute myocarditis following abdominal operation occurs oftener than commonly supposed, and should always be watched for. Is it probably due to streptococci lying in the gall-bladder or appendix, with a selective affinity for the heart muscle, as described by Rosenow?

In considering these few cases to which I have referred, there being one death—postmortem not allowed—it has occurred to me that I might gather some additional facts in looking over the records of the following autopsies, secured at the Bender Laboratory, which have a direct bearing upon the relations between the condition of the gall-bladder found and that of the heart.

In the study of these eight autopsies, bearing directly upon the gall-bladder conditions, without operation, made at the Albany Hospital and elsewhere, during five years, the following conditions are to be noticed

## MYOCARDITIS FOLLOWING ABDOMINAL OPERATIONS

There were five males, three females, ages 70, 72, 62, 56, 60, 47 and 42 (one age or condition not stated) Jaundice present in six cases

CASE I —Male, age seventy, acute and chronic cholecystitis Gall-bladder distended, adherent and contained thick yellowish-brown fluid, twenty-one gall-stones Heart 320 grams, otherwise negative in gross appearance Microscopic examination not completed. It will be observed that the heart in weight was above normal. Cause of death recorded, chronic cholecystitis

CASE II —Adult, female, bronchial pneumonia, and of which she died Gall-bladder wall greatly thickened, two large masses resembling burrs found Cystic duct entirely occluded Heart right markedly dilated, myocardium brownish in color

CASE III —Female, age seventy-two, jaundice Gall-bladder small, many adhesions, two large round stones Heart 220 grams, muscle flabby, dilated right heart Microscopic fibrous myocarditis Cause of death, carcinoma of the liver

CASE IV —Male, age sixty-two, jaundice Patient died within few hours after entering the hospital There was found acute cholecystitis, with perforation, fifty faceted calculi Acute general peritonitis Heart normal Cause of death, general peritonitis

CASE V —Female, age fifty-six, jaundice, died of pulmonary oedema Gall-bladder very adherent, small, many small gall-stones, one in hepatic duct Oedema of the lungs very pronounced Heart walls collapsed, musculature brownish color, soft and flabby Microscopic Apparent oedema, few lymphocytes scattered about Cause of death, oedema of the lungs

CASE VI —Male, age sixty, gall-bladder small, adherent, several faceted gall-stones Heart dilated, mitral and aortic thickening, with calcification, coronaries slightly sclerosed, weight 450 grams Cause of death, acute dilatation of the heart

CASE VII —Male, age forty-seven Gall-bladder thickened, filled with muco-purulent material, many stones present, ducts obstructed, acute hepatitis Heart cavities normal, musculature flabby, coronaries negative Microscopic Chronic fibrous myocarditis, subacute pericarditis Cause of death, subacute myocarditis

CASE VIII —Male, age forty-two, jaundice Gall-bladder distended with bile, ulcerated, acute and chronic hepatitis Heart, both sides flabby, muscle soft and pale, increased fibrous tissue, numerous leucocytes, few plasma cells and polynuclear leucocytes Microscopic acute and chronic myocarditis Cause of death, subacute myocarditis

While these cases may be of little value, I feel somewhat hopeful that something to aid in our future early recognition of acute dilatation may develop and operative surgery meet with less of the few remaining defeats that may be our lot to come in contact with They also carry out the conclusions so well expressed by Dr Wm J Mayo, that gall-stones may be considered foreign bodies, and, other things being equal, the earlier these foreign bodies are removed the better for the patient

# EPIGASTRIC HERNIA WITHOUT PALPABLE SWELLING\*

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IN a previous communication upon the subject entitled "The Pathogenesis of Hernia of the Linea Alba," I believe I have proven quite conclusively that in by far the largest number of these herniæ the condition is not a hernia in the true sense of the word. From time immemorial the term "hernia" has come to mean a protrusion of a peritoneal sac. This is so generally acknowledged that we look upon the presence of a hernial sac as an essential requirement of all herniæ. In epigastric hernia, however, a peritoneal sac is of exceptional rarity, I have not examined my statistics regarding this point, but I am safe in stating that not more than one case in twenty has a true hernial sac. Even in the cases which do have a hernial sac, the sac is only a secondary acquisition, and is found only after the hernia has attained a sufficient magnitude to pull out a peritoneal diverticulum. In the paper already quoted I have also demonstrated that in most of the cases the bulk of the protruded mass is not, as is commonly assumed, composed of omentum, but is merely a prolongation of the fat enclosed between the two peritoneal layers forming the falciform ligament of the liver. The commonest form of epigastric hernia is sacless, and one in which the peritoneum is not involved in the least.

Epigastric hernia differs from all other herniæ also in a further important attribute, namely, that it has a very distinct symptom complex. By far the greatest majority of uncomplicated herniæ in other parts of the body are symptomless. On the other hand, I have found the symptomatology of epigastric hernia to be so constant that its absence in a doubtful case would be sufficient to exclude the diagnosis of such a hernia. It is true that the symptoms of an epigastric hernia are little known and quite vague, still they are fairly characteristic. The patients usually complain of eructations, nausea, and periodic attacks of pain, which they localize into the entire epigastrium. These complaints are not unlike those we are accustomed to see in ulcers of the stomach or duodenum, with the difference, however, that they do not bear such a constant relation to the ingestion of food. I do not intend to discuss in detail the differential diagnosis between epigastric hernia and gastric ulcer. I merely wish to point out that the symptomatology of an epigastric hernia, no matter how large, or how small, has a striking similarity to that of a gastric ulcer.

As for the physical examination we find in epigastric hernia first of all a mass situated at or near the median line of the abdomen, some place between the umbilicus and the xiphoid appendix. The smaller herniæ

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\* Read before the American Surgical Association, June 1, 1917

## EPIGASTRIC HERNIA WITHOUT PALPABLE SWELLING

appear to be situated directly in the median line, in their subsequent growth, however, they usually extend away from the median line, usually towards the left side

The hernial protrusion varies greatly in size, in the majority of the cases the mass is very small, rarely larger than a marble. In some cases the hernia is very small, sometimes not larger than a pea or a lentil, in consequence of which, and more particularly in the obese, it is very difficult to palpate. Occasionally all that is discoverable, either on inspection or upon the gentlest palpation, is a very slight elevation in the midline of the abdomen. I have found that the best way to practice inspection in these small herniæ is to stand at the head of the patient, and then to examine the linea in not too brilliant illumination so as to note the slightest differences. The palpation in these cases is best practiced with the aid of a single finger.

Irreducibility of the mass is a very frequent characteristic of epigastric hernia.

I am now coming to an unappreciated and yet absolutely constant physical sign of epigastric hernia, namely, that no matter what the symptoms caused by the hernia, no matter what the size of the hernia, no matter whether reducible or not, no matter whether the patient is of the phlegmatic or hysterical type, the hernial protrusion itself, and more particularly the ring or opening through which it makes its escape into the subcutaneous tissues is always very tender. This is so characteristic that in the very smallest herniæ, *i e*, those which cannot be palpated with an absolute certainty, the diagnosis of an epigastric hernia can and should be made by finding such an extremely tender point in the midline of the abdomen. All cases giving a history resembling vaguely that of a gastric ulcer should be examined for a small epigastric hernia, this examination is materially aided by finding a tender point in the midline of the abdomen. Difficulty arises only in such cases in which there appears to be a combination of the two maladies, namely, an epigastric hernia complicated with a gastric ulcer; but even in these a differential diagnosis ought to be made with comparative ease. The tenderness in gastric ulcer is not as superficial nor as sharply circumscribed as in epigastric herniæ. The cause of the pain in cases of epigastric hernia is still a moot point. The early writers upon the subject (Garengeot, Pipelet, etc), were of the opinion that the gastric distress complained of by these patients was due to the fact that the stomach formed the most frequent hernial content. Subsequently writers accepted this statement of Garengeot tacitly. Only within comparatively recent years was the frequently assumed presence of the stomach as a hernial content disproven. I believe that the pain is merely a referred pain, and is caused by a dragging upon the falciform ligament of the liver.

As far as I know the tenderness in the protruded fat and also in the hernial ring has never before been described. As already stated I have not failed to find it in a single instance, it is very surprising to me that it should have escaped attention till now. It is such a constant symptom that

its explanation ought to be apparently very easy. Unfortunately it is not, and I confess that thus far I am still undecided as to the reasons for the tenderness. There are several possibilities. I am now investigating this point, but my investigations are not yet sufficiently advanced to permit me to speak authoritatively. When these investigations have been completed I shall be glad to report upon them.

In view of the uncertainties regarding the causative factor of the pain and of the tenderness in epigastric hernia I wish to call attention to a symptom complex resembling that of the commonly accepted epigastric hernia in every respect, and yet there was not even an indication of a hernia present.

My observations are based upon two cases only. I shall therefore give their histories with some detail. Both cases were referred to me by Dr Seymour Basch, and I avail myself of this opportunity to express my appreciation for the careful preoperative observation and the notes of the cases.

CASE I—Mrs M M, thirty years of age. Patient was operated upon three years ago for a chronic appendicitis, after two attacks of a rather acute character. At the operation many adhesions of the omentum were found. Previous to the operation the patient suffered also from frequent attacks of nausea, which she relieved by inducing vomiting. Since five years the patient also complains of peculiar attacks of sneezing, which occur irrespective of time and place, on awaking in the morning she would sneeze a number of times in succession, followed by a discharge of a watery fluid from the nose, however without the sensation of nasal obstruction. Patient has had all kinds of local and general treatment, but entirely without any success.

Extirpation of the appendix had no influence whatsoever upon her previous complaints. The nausea and vomiting promptly recurred. Patient married shortly after operation. During the first six months of the ensuing pregnancy patient vomited so much that she was unable to retain anything. In spite of this, however, she felt too well to remain in bed for any length of time.

Patient is decidedly of the phlegmatic type. Skin and mucous membranes rather pale. Examination of the heart, lungs, and central nervous system is negative. The urine shows no abnormalities. No goitre is present, and there are no enlarged lymphatic glands. The abdomen was slightly pendulous. The right kidney is slightly ptosed, the greater curvature of the stomach appears to be at the level of the umbilicus. One and one-half inches above the umbilicus, in the linea alba, there is a small and persistent point of tenderness, patient winces with pain when pressure is exerted upon this point, this point is localizable with an absolute precision, it was also impossible to elicit another similar point throughout the entire abdominal examination. Not even the slightest indication of a mass, such as a small epigastric hernia would give, is to be felt. This point of tenderness and its exact location and invariability were verified upon a number of subsequent occasions.

## EPIGASTRIC HERNIA WITHOUT PALPABLE SWELLING

Examination of the stomach contents one hour after an Ewald test breakfast showed 58 total acidity, and 36 free HCl, no gross or microscopical abnormalities. The thread test was negative. X-ray examination of the stomach and intestines was also negative.

Had a physical examination of this patient revealed even the slightest indication of a swelling at the point of tenderness in the midline of the abdomen, its presence taken in conjunction with the history would have induced me to make the diagnosis of an epigastric hernia without the slightest hesitation. In the absence of such a swelling, however, I refrained from making any diagnosis at first. On subsequent examinations I finally decided to operate, upon the presumptive diagnosis that an impalpable hernia existed.

Operation, March 17, 1915. The dissection was carried out with the greatest care, in order not to destroy the evidence of our findings. One and one-half inches above the umbilicus, in the linea alba, exactly at the point of the persistent tenderness, there was encountered a good sized vessel surrounded by a delicate fascia, which escaped through a transverse elliptical opening in the linea alba. No trace of a fat protrusion was seen. The vessel was ligated, and the part distal to the ligature cut away. The proximal stump was pushed back into the hole, and the latter closed with one Pagenstecher suture. Patient made an uneventful recovery.

Under date of January 1, 1917, I heard from Dr. S. Basch, that her recovery was startlingly rapid, and the result persistently good. Patient lives out of town, but reports to me from time to time. She has gone through another pregnancy since the operation, and absolutely without any trouble.

CASE II—Miss D. J. R., twenty years of age, single, was also referred to me by Dr. Basch. At the age of five months, patient had whooping cough, which lasted an entire year, and was accompanied by a great deal of retching and vomiting. Four years ago, patient was operated upon in a neighboring city for appendicitis. Patient suffers from habitual constipation for practically her entire life, in consequence of which she is compelled to continually take laxatives.

For many years patient has been suffering from recurring attacks of nausea in the morning, which usually occur on arising and disappear spontaneously in the course of the forenoon; occasionally the nausea is so severe that patient also vomits. These attacks of nausea are increasing in frequency, so that hardly a day passes by without an attack. They were absent for a very short while only after the operation for appendicitis.

Physical examination is negative except for the following:

There is a definite circumscribed point of tenderness in the linea alba, two and one-half inches above the umbilicus. This point of tenderness is found upon repeated examinations and at various intervals. No other point of tenderness is elicited anywhere upon the abdomen.

Examination of the stomach contents one hour after an Ewald-Boas test meal showed a total acidity of 72, and free HCl 42, microscopical examination was negative.

She was treated at first symptomatically with appropriate diet, rest, and abdominal bandage, and the internal administration of validol, however without relief

In the absence of any definite physical signs I was at first averse to suggest an operation. But having in mind the excellent results obtained in the practically similar Case 1, I suggested the consideration of an operation. This was carried out July 24, 1916. The linea alba was exposed through the longitudinal incision, and at the point exactly two and one-half inches above the umbilicus a vessel was seen emerging from the linea alba, through a small transversely oval opening. The vessel was ligated between two ligatures, the proximal stump pushed back and the opening closed.

After operation patient at first perfectly well, again suffering from time to time with nausea, but finally this disappeared completely, and now, ten months after operation, she feels perfectly well.

To recapitulate in brief the salient points of these two cases they were the following

- 1 The symptoms were remotely suggestive of those of an ulcer of the stomach, and therefore also those of the well-observed cases of epigastric hernia

- 2 The principal physical sign was a localized area of tenderness, of the size of a lead pencil, in the middle of the abdomen, between the umbilicus and the xiphoid appendix

- 3 The complete absence of a true hernia of the linea alba, and also the absence of the merest indication of one, as might be represented by a small lipomatous outgrowth contiguous with the fat contained in the falciform ligament of the liver

- 4 The sole finding at the operation was the blood-vessel normally present, which pierced the linea alba exactly at the previously outlined area of tenderness. The opening in the linea alba was perhaps larger than is normal

- 5 A cure and complete relief of all symptoms by simple ligation of the vessel, pushing back of the proximal stump, and closure of the opening

I have searched the literature most carefully, but I have failed to find a single similar case. Singularly, however, I found an article by Mohr,<sup>2</sup> with practically the same title as I have given to this article, namely, "Über Hernia Epigastrica ohne fühlbare Geschwulst," in which the author gives a short history of two cases which he had observed, he also quotes other authors as having seen similar cases.

MOHR's cases are immensely interesting. I will be pardoned, therefore, if I abstract same.

CASE I—Male, forty years of age, who had been suffering for years with digestive disturbances, namely, irregular, occasionally extremely severe, coliclike attacks of pain in the upper abdomen. He was treated for a very long time by internal medication, and about two years before coming into Mohr's care had been operated upon by another surgeon, he was told, for a median (epigastric?)

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hernia, the operation, however, brought the patient no relief from the symptoms, which returned promptly after patient left his bed. Fifteen months later patient was again operated upon by another surgeon, for the cure of a ventral hernia in the cicatrix of the previous operation. After this operation the attacks disappeared for six weeks, but then recurred in their old severity. Mohr saw the patient eight months after the second operation, and at his examination found that the patient was greatly emaciated and apparently suffering greatly. In the linea alba above the umbilicus there is to be seen a well-healed cicatrix of the previous operation, without any trace of a ventral hernia. Two fingers' breadth above the upper end of the incision, and exactly in the midline of the abdomen, there is a sharply circumscribed localized point of tenderness, which is so small that it can be covered by the tip of a finger, everything else is negative. On repeated examinations this point of tenderness was never found to vary, the vicinity of this point and the cicatrix of the previous operation were not in the least tender. Patient insists that his pains originate in this tender point. He was operated upon by Mohr, who found, behind the old cicatrix, extensive adhesions between it and the linea alba, colon and omentum. Above the cicatrix the parietal peritoneum was free from adhesions, only a long drawn-out piece of omentum was adherent between the stomach and the tender point, a hernia sensu strictu was not present. The adherent tip of omentum was ligated and liberated. Primary union. Patient was absolutely free from pain from the date of operation, and this freedom continued up to the time of publication (five months).

**Epicrisis** It is perfectly possible that Mohr dealt with just such a case as I have reported, but judging merely by his description one must naturally arrive at the conclusion that the case is by no means proven. It is true that no hernia was seen, in fact, nothing was seen that would remind one even remotely of one, all that was seen was a mass of adhesions, originating from the two previous operations, and a bit of omentum adherent in the midline of the abdomen, all of which may be sufficient to explain the symptoms, but is not sufficient to entitle an author to publish the case as one of epigastric hernia without any palpable tumor.

CASE II was also a male, thirty-four years of age, with an anamnesis and symptoms similar to Case I. Physical examination showed exactly in the midline of the abdomen, three fingers' breadth above the umbilicus, a constant, sharply circumscribed point of tenderness. Patient suffered so much that an exploratory operation was advised. Incision of the abdominal wall down to the transversalis fascia failed to show signs of a hernia, only when this fascia was incised, at the previously described point of tenderness, a lump of fatty tissue popped out. As this was pulled open the peritoneum tore, and it was then seen that the fat was the end of a bit of omentum, which ran to the stomach, and the free end of which escaped through the hiatus in the linea alba and then became incarcerated. This portion of the omentum was ligated and replaced into the abdomen. Patient is free from pain since the operation. A few months later he again suffered from an attack of abdominal colic, but Mohr believes that it had nothing to do with his previous operations. At the time of publication (four years) patient is still free from all trouble.

**Epicrisis** The case is not absolutely acceptable as one of epigastric hernia without palpable swelling, for the following reasons. The description is not quite clear. That fat protruded when the transversalis fascia opposite the tender point was incised is no criterion, because this is found



to occur wherever the falciform ligament is attached. Furthermore the case was complicated by an intra-abdominal pathological condition, which in itself may have been the cause of the symptoms and not the hernia.

Mohr quotes from the literature, so to say, in fortification of his standpoint, other cases, which on analysis, however, are not bona fide cases of epigastric hernia without palpable swelling.

Kuttner<sup>3</sup> gives an excellent résumé of the subject of epigastric hernia, particularly as it bears upon the gastric symptoms. He also emphasizes the fact that even sacless epigastric herniæ, *à e*, such composed only of a subserous lipoma, give similar symptoms, but he does not mention epigastric herniæ without any swelling. His smallest case was evidently the size of a lentil, but even this was palpated perfectly before operation.

Mohr next quotes Liniger,<sup>4</sup> but this author reports no case as belonging into this group, he merely says that occasionally the smallest epigastric herniæ give rise to the severest symptoms. Thus one hernia, the size of a pea, gave rise to such severe symptoms that patient was prevented from taking sufficient nourishment.

TEMOIN<sup>5</sup> records a most interesting case of vomiting which had existed for over one year, and which defied all internal medication. Absolutely nothing was found on examination, as far as inspection and palpation were concerned, except a point of extreme tenderness between the umbilicus and xiphoid appendix, pressure upon which brought on an attack of vomiting. Temoin advised an operation, and on very careful dissection he found in the median line a small omental hernia, which was twice as large as the head of a pin, and which it was naturally impossible to discover by palpation. It had no sac, and was directly contiguous with the omentum (?). Resection and closing of the wound were followed by complete recovery.

**Epicrisis** This case is perhaps nearer than any other one to my cases. The hernia was certainly very small, exceedingly small, but still fat was present, a fact which differentiates it from my cases. I do not wish to speak of the other erroneous observations of the case, such as continuation with the omentum.

Wittgenstein and Grosse<sup>6</sup> give an excellent résumé of the subject, but quote no case.

METZGER<sup>7</sup> reports a case which is so interesting that a verbatim translation is justified. The patient was a male, forty years of age, who complained of pain in the stomach, and in whom a hyperacidity was found. Metzger found in the linea alba above the umbilicus a very tender point, and as no benefit whatsoever was obtained from medicinal and dietetic treatment, he referred the patient to the surgical clinic in Tübingen for operation, no hernia was found, nevertheless patient was completely cured by the operation.

Metzger says that most probably the case was one of those small slit-like openings in the fascia, which was cured by the suturing of the divided fascia.

**Epicrisis** This case resembles in many details the two reported by me. It is regrettable, however, that the author did not operate the case in person, and that the report is therefore second hand, so to speak.

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It is perfectly possible that the observations I have made in the two cases I reported are well known, and therefore hardly worth while placing on record. However, I have, as already stated, failed to find any reference whatsoever to such cases in the literature. Mohr's cases can hardly be said to be true cases of epigastric hernia without palpable swelling, because they were complicated by intraperitoneal adhesions, etc. The cases he refers to, to fortify his stand, were at best very small hernia.

The choice of the title of this article, "Epigastric Hernia Without Palpable Swelling," is not entirely satisfactory to me, because I have not brought forward any valid proof that the symptoms in these cases were due to an epigastric hernia. There are to my mind only three possibilities to explain the symptoms and their relief by operation. The fat protrusion may have been so small as to escape attention. I do not believe this, because both cases were operated upon with the most punctilious care, in order not to destroy any evidence of a protrusion. It is reasonably possible, that the fat protrusion may have been present, but that it was absent during the operation, while the patient was anæsthetised, this does not appear to me to be probable, because I believe that the protrusion would have become evident in the course of the operation. I purposely pulled upon the vessel to render any temporarily reduced fat protrusion visible, but I failed to do so. A third possibility is that it was an epigastric hernia, in which the fat protrusion had not yet escaped beyond the linea alba, that is, that it was, so to say, an interstitial form of an epigastric hernia. I look upon this explanation as very probably the true one, and I base my opinion upon the following facts. First, the symptomatology which is absolutely identical with that of a complete epigastric hernia, second, upon the identical pathology, and finally also upon the perfect cure, which ensued upon simple ligation and division of the vessel, and closure of the opening through which it escaped.

I believe the subject is of some importance, particularly on account of its close resemblance to gastric ulcer. I hope my observations will be verified.

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- <sup>4</sup> Liniger, *Monatsschrift f Unfallheilkunde*, 1902, vol xx, page 391
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- <sup>6</sup> Wittgenstein and Grosse, *Medizinische Klinik*, 1907, page 1450
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# PARAFFINE HERNIA<sup>\*</sup>

HERNIA COMPLICATED BY PARAFFINE INJECTIONS

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THE title for this communication is open to criticism, for it does not strictly comply with the usual definition of hernia. If we insist that only those defects which consist of "a protrusion of any viscus through an adventitious opening in the wall of the cavity which contains it," we can hardly reconcile it with the designation of paraffine hernia. For it has been shown that only occasionally is injected paraffine found within the hernial sac and then it does not protrude through an adventitious opening and it is not a part of the anatomy of the carrier. It has found its lodgment from without and not from within and is an extraneous foreign substance. But we will use the term for our convenience to describe a series of cases where paraffine was used with the intent to cure hernia. These findings have been described inaccurately as paraffinoma. We really have hernias complicated by paraffine.

Since Gersuny introduced paraffine for prosthetic purposes, the method has been employed for a series of widely differing surgical defects. Undulating nasal backs, sunken cicatrices claimed the early attention of operators, later followed efforts to maintain prolapsed uteri and descended rectal termini, and urinary incontinence was said to be controlled by it. Cleft palate received due attention, facial blemishes that were existant and those that still remained in expectancy became the monopoly of the beauty doctor. In the course of time the herniologist, after he had found wanting and had discarded the local injection of alcohol, tannic acid solution, chloride of zinc and many other curatives, and the application of his inefficient but marvelously constructed trusses that were credited with magical power had failed, pounced upon paraffine as the all-saving and never-failing cure-all for hernias of all descriptions. Gersuny had informed the surgical world that paraffine when injected subcutaneously set at once, and it became a smooth, easily moulded, unchanging, painless, and unirritating support. It was not long before some fertile-minded genius bethought himself of making a stopper for the inguinal canal to prevent the spilling of an intestinal coil and he believed it could be modelled into any shape that the requirements of the operator suggested. Our specialist then claimed the field for his endeavors, and when he announced himself as prepared successfully to do this work without knife or pain and no detention from business, he certainly had come into his own, for he still flourishes beyond all measure. His few

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<sup>\*</sup>Read before the American Surgical Association, June 1, 1917

devotees extol his achievements and his many dupes are eloquent in their silence His promising advertisements still maintain a long waiting list

It may interest us to consider some personal observations on the end results of a few personally observed cases of hernia that had subjected themselves to paraffine injections

It has been the writer's privilege to have operated and removed the paraffine in ten of these cases, in all of whom the hernia still persisted All of them applied for treatment because the hernia continued to be uncured, and in every one the pain and discomfort had become continually more severe and in several instances unbearable

It seems that the object aimed at in the paraffine injection method is to create a plug in or at the inguinal canal which is designed to create a stopper or cork to retain the hernial loop in its normal location, very much like the cork in a bottle Theoretically such expectation might, in a measure, be expected if the cork were always accurately applied and filled the inguinal canal completely from external to internal ring, preventing the descent of an intestinal loop into any part of the canal It is not clear whether the intention has been to inject the paraffine into the hernial sac, filling that portion constituting its neck, or whether the paraffine is to be introduced external to the sac to compress its neck so as to prevent an intestinal descent

Whatever may have been the intent of the originators of the procedure, the practical workings have been uncertain The widely differing relations of the injected paraffine to the inguinal canal, as shown by the cases here reported, indicate either the impossibility of an accurate control of the injection or an ignorance of anatomy of the inguinal canal and the nature of hernia on the part of the operator, or both

When one takes into account the impossibility of ascertaining clinically the exact size of the hernial sac, whether it can be pushed back with the reduced hernial loop or whether it extends partly or completely into the scrotum, or whether there exist omental adhesions, whether the sac wall is thin or thick, whether the canal is long or short and in some cases whether hernia is direct or indirect, it becomes clear that no matter how accurate the knowledge of anatomy or however skilful may be the planting of the paraffine, the method must be inaccurate and if successful in placing the injected mass so that it will hold the hernia, is as much of an accident as its promiscuous distribution in, around and beyond the actual defects as found in the average case

When we recall the endless varying conditions found at an open operation and the impossibility of determining in advance of an exposure of the parts the altered anatomical landmarks, it becomes clear that any treatment that is administered by the subcutaneous method lacks all essential of accuracy and its technical uncertainties should condemn it

In all of the cases to be herein detailed there were no two cases in which the paraffine occupied the same anatomical structures, nor was there any uniformity as to the quantity deposited In the greater number of cases

the injected material was found outside of the hernial sac and the inguinal canal. In one case the paraffine mass was larger than an ordinary fist and it extended from the pubic tuberculum to the anterior iliac spine. In another it was deposited in several masses about but outside of the external ring and extending down along the descending pubic ramus of the urethra. In one instance the hernial sac was almost filled with a mass the size of a hen's egg, it extended nearly to the internal ring like a cork, but it was not sufficient to retain the hernia—a hernial loop had slipped down beside it. In another case the paraffine was so small in amount that only a small, flat, fibrous nodule, outside of and attached to the cord, remained.

In a number of cases several injections had been made at different sittings, as many as seven injections in one case, because the hernia recurred after each treatment. In several instances the paraffine was found outward to and above and in several below the inguinal canal without effect for better or worse in the defect except to produce pain which had not existed before.

We naturally ask ourselves, What becomes of the injected paraffine? Gersuny and others insisted that it remained unchanged in the tissue. That is apparently true in many instances, but not invariably so. In referring to our own cases, several masses that had been injected into the loose areolar tissues in the groin, and particularly in obese subjects, the masses were round and had smooth surfaces, they were easily shelled out, there were absolutely no connective tissue attachments. The cavities, from which the nodules were removed, were smooth. No attempts had been made to create limiting membranes of connective tissue. In the older cases, where the masses had been made more than two years previously, the limiting membranes were distinct. In one case two distinct masses of paraffine, one anterior and one posterior to the cord, had been injected eight years previously and remained unchanged.

The masses found within the hernial sac were unchanged. There was no noticeable change in the endothelial lining of the sac except at the point where the needle had entered, at that point there was a distinct fibrous attachment, its fibres entering the paraffine itself.

At points where the paraffine had been deposited in dense tissue like the fascias and in the inguinal canal external to the sac, the masses were adhered by a development of connective tissues which penetrated the paraffine. This was particularly true of the smaller masses, and in one instance, where the original mass probably was no larger than an almond, the entire mass was permeated with connective tissue, breaking up the paraffine into innumerable small globules. In one case, aside from a nodule that had been injected near the internal ring, a part of the paraffine was deposited accidentally intradermally and immediately beneath the papillary layer, creating a reddened indurated area. A microscopical examination of this dermal nodule showed an invasion of connective tissue, breaking the mass into numberless small globules, suggesting an attempt at final absorption.

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How long may paraffine remain in the tissues before absorption, if it ever does, is complete? This question may be illustrated by an experience not connected with hernia, but by a case that had been a carrier of paraffine that had been injected four years previously

A middle-aged attractive woman had been persuaded by a beauty doctor that he could endow her with perpetual youthful facial beauty if he would be permitted to inject paraffine at points in her face usually occupied by wrinkles which were the forerunners of senile manifestations. She readily consented. Masses of paraffine were deposited above and between the brows, the outer corners of both eyes and the angles of the mouth and in the nasal folds, and, to complete the cosmetic work, several globules were injected to improve the nasal contour. All the injections were subcutaneous. For a short period following the treatment there were no visible changes. In about three months reddened areas developed over all the injected points. These areas became more pronounced, increased in extent so that the face finally presented the appearance of an extreme chronic alcoholic.

When she presented herself for consultation, which was more than four years after the treatment, she exhibited extremely reddened and distorted features with prominent nodules at all injected points. Her nose was especially large and swollen like that of the proverbial coachman.

She desired to have the paraffine removed. It was finally decided to excise it with a scalpel. Every nodule was firmly attached to and was permeated by connective tissues, they were dissected out with difficulty. The pathologist's report by Dr O S Schultz was as follows:

Considering the duration of the inflammatory process set up by the action of the injected paraffine, the lesion is striking in the absence of differentiated fibrous tissue and of newly formed blood-vessels. In spite of the latter factor, necrosis is absent, peripherally, as well as further in, the inflammatory tissue has the same subacute, proliferative character, and there has been no peripheral walling off by fibrous tissue. The injected paraffine is absent in the prepared sections (it was probably dissolved out in the staining process), but there can be no question but that the spaces present, and they were numerous, in the tissues represent the situations of the paraffine. The latter, since it is not removable, must act continuously as an inflammatory irritant. The character of the tissue reaction indicates that it acts as an irritant of low grade of intensity. Where the paraffine was present in larger amounts it appears to have caused hyaline degeneration and atrophy of the stroma rather than proliferation.

While the paraffine is not soluble and cannot be completely removed, it apparently can be broken up by the proliferating tissues, as the small size of the vacuoles in the more cellular tissues and the vacuoles present within the giant cells would indicate. In order that fragmentation of the paraffine could occur, the injected paraffine must have had a low melting point which rendered it soft at body temperature. The prolonged and continuous inflammatory reaction set up in this case shows that paraffine injected into the tissues cannot be considered an entirely inert and innocuous substance.

In studying our cases it was found that the least change took place when the paraffine was deposited in loose connective tissues. Moderate changes in form of connective tissue invasion occurred when it was deposited in dense structures. If deposited intradurally about the inguinal canal or intradermally it infiltrated the tissues and became a source of irritation, setting up a prolonged and continuous inflammatory process. When the mass was deposited in loose areolar tissues there was no apparent inflammatory reaction except for the formation of a limiting connective tissue wall. The paraffine masses remained unchanged. The amounts injected varied greatly. The smallest amount was not less than one drachm and the largest quantity weighed sixteen ounces.

This brief discussion is based on a report of the following cases, ten in number, which were operated by the writer for the removal of the injected paraffine with an intention to cure hernias.

CASE I —A B, merchant, weight 225, age forty, entered my service at the Methodist Episcopal Hospital suffering with urinary retention due to organic stricture situated in the prostatic urethra. Forcible catheterization previous to admission had produced traumatism leading to perineal urinary and sanguineous infiltrations. A sound could be passed only to the prostate. Six months earlier he had been subjected to paraffine infiltrations for the cure of a large right-sided inguinal hernia. In spite of a thick layer of adipose tissue on the abdomen and in the groin, a hard mass the size of a goose egg could be palpated over the external inguinal ring and another extending downwards into the scrotum and smaller masses in the perineum. A suprapubic puncture to relieve urinary retention had been attempted without success. The urgency for the relief from the distress of an overdistended bladder was great. A suprapubic cystotomy, under ether, was done shortly after admission. The bladder being opened and emptied of a large amount of urine, a block tin sound was passed into the upper urethral end down to the prostatic obstruction. A median perineal incision was made dividing the cicatricial structures down to the point of the sound. The tissues involved in the stricture were divided so that the tip of the sound could be pushed through the perineal wound. A mass of paraffine about the size of an English walnut firmly imbedded in the tissues and lying to the right side of the urethra anterior to the prostatic urethra was removed. This mass extended upwards and was connected with the paraffine near the external inguinal canal. A rubber tube was introduced protruding from both suprapubic and perineal wounds creating a through-and-through drainage. The day following his operation he had completely recovered from the conditions of shock which existed when he entered the hospital, but he complained of pain in the right groin at the site of the paraffine mass. He had had a free bowel movement during the night and, since no intestinal protrusion in the right groin could be felt, it was hoped that the local pain was due to paraffine irritation. The pain became less in the course of a week.

On the tenth day there was a sudden enlargement of the mass in the groin accompanied by intense pain. It was apparent that an intestinal loop had descended beside the paraffine, resulting in incarceration. An immediate operation confirmed this conclusion. An incision through the thick layers of fat disclosed a hard goose-egg-sized mass over the external inguinal canal. Other rounded nodules were felt, one extending upward along the groin to the extent of four inches. A second one, ovoid in shape, extended downward to the perineum. A third one extended into the obturator foramen, a fourth mass pointed along the surface of the horizontal pubic ramus. All normal anatomical lines were obliterated. Each mass was firmly attached to the tissues and was dissected out with difficulty. After their removal the spermatic cord was found to be infiltrated so that it presented itself like a section of hard rawhide cord. The hernial sac wall was stiff and hard, as if it contained paraffine, but none was found in its interior. A mass at the external ring had compressed the circulation in the intestinal loop within the sac so as to obstruct its circulation, giving the appearance of a strangulation. The hernia was closed by the imbrication method. The entire mass of paraffine removed exceeded the size of a double fist and weighed sixteen ounces. A great deal of paraffine remained infiltrated in the tissues which could not be removed.

CASE II—G. L., aged forty, a stock dealer. One evening the writer was summoned in haste with instructions to bring a complete operating outfit to operate a strangulated hernia on a man at his own home. His condition seemed to forbid his being moved to a hospital.

On arriving at the bedside, a strangulated right-sided inguinal hernia, complicated by a large mass of paraffine which had been injected more than a year previously, was found. The patient was in great pain, had an almost uncountable pulse, rapid, shallow respirations; in every way he seemed in extremis. Hasty preparations for an immediate operation were made. Under a rapid light ether anæsthesia the operation was begun. The usual incision revealed a large flattened mass of paraffine, which extended upward from the external inguinal canal to the extent of four inches and outward along the inguinal canal to a distance of five inches. Three hen's-egg-sized paraffine nodules were embedded below Poupart's ligament in Scarpa's triangle, another, a walnut-sized nodule about two inches below the external ring and between this and the first-named mass could be felt, the hernial sac was tensely distended and almost black in color. All these masses were intimately and firmly attached to the surrounding connective tissues. A most tedious dissection followed. All normal anatomical lines were obliterated. Finally all the paraffine was removed. The sac was opened, it contained a black intestinal loop which still retained its gloss. It was returned into the abdominal cavity. The hernial canal was repaired with tier sutures by the usual imbrication method. Recovery uneventful.

CASE III—J. S. M., age twenty-five, admitted to my service at the Methodist Episcopal Hospital. He was suffering from an irreducible left-sided inguinal hernia. A hard hen's-egg-sized mass could be palpated overlying the external inguinal canal. The patient volunteered



the information that he had undergone the paraffine treatment eight months ago. Under ether anæsthesia, and through an incision, an ovoid mass of paraffine, the size of a large hen's egg, was easily shelled out, leaving a distinct coating of paraffine in the walls of its bed and extending into the hernial canal and infiltrating the spermatic cord. The inguinal canal was large enough to permit the passage of an intestinal loop. The pressure from the paraffine interfered with the return circulation and effectually prevented a reduction of the hernia. After dividing the fascia of the external oblique up to and above the internal ring, the hernial sac was opened, the intestinal loop was intensely congested but retained its gloss. It was reduced. The closure of the canal was with chromic gut sutures. Recovery was uneventful.

CASE IV—J. G., railroad brakeman, age thirty-five years. More than a year prior to admission he had undergone the paraffine treatment, but his hernia had recurred and it had become very painful.

On examination there were found in his left groin three hard spherical masses. Two of these were the size of English walnuts located below Poupart's ligament, and a third, the size of an ordinary lemon, was firmly attached to the fascia of the external oblique at a point between the external and internal inguinal rings, exerting only enough pressure on inguinal canal to interfere with a return of the protruding intestinal loop. This mass was only loosely attached to the subcutaneous tissues but firmly adhered to the oblique fascia. The two smaller masses were only loosely attached and were easily removed. The usual radical operation completed the operation (Ferguson-Lucas Championniere). Recovery smooth.

CASE V—C. F., age twenty-five, farmer. Right-sided oblique inguinal hernia treated with paraffine eighteen months prior to his visit to the writer. An examination revealed a hen's-egg-sized, irreducible, fluctuating swelling at the right external ring. Cough and strain produced a distinct impulse. Over that swelling and to its outer side, nearly within external ring, existed a hard, rounded, circumscribed, walnut-sized mass. It was not freely movable. It appeared firmly attached to the muscular fascia. It appeared that the hernia reappeared soon after the treatment, although several paraffine injections were given. At first reduction could be effected by palpation, but for a year past the hernia could not be reduced. Much pain and discomfort gradually developed.

*Operation*—The usual inguinal incision disclosed both hernial sac and paraffine mass at the same time. The paraffine being more prominent was removed. It was firmly attached to the external oblique fascia by connective tissue evidently penetrating the mass. The loose areolar connective tissue had become closely attached to the paraffine so that the mass was dissected out. The mass was pressing on the outer side of the inguinal canal so as to materially reduce its lumen and seemed to interfere with reduction.

In the hernial sac there was a small amount of paraffine which was attached by connective tissue filaments to the intestinal and sac walls. The paraffine was easily detached, leaving a small area of defective

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intestinal serosa which was infolded with several sutures before the loop was returned. The usual radical herniotomy terminated the operation.

CASE VI—I O D, farmer, age twenty, appeared at the usual afternoon consultation hour. He stated that nearly two years previously he had received one paraffine injection for the cure of a right inguinal hernia. The injection had been made without any previous preparatory treatment except that the hernia was reduced. The operator used a syringe consisting of a metal barrel that would hold about two ounces. To it was attached a long needle. This was plunged through the skin without the slightest attempt to disinfect it. A small amount was forced into the region over the external canal. In twenty minutes he was pronounced cured. The fee having been paid in advance, he was politely invited to retire.

An examination revealed a small, illy-defined hard mass no larger than an almond over the external canal, a hernial loop was lying below it. Reduction was effected with difficulty.

*Operation*—An incision laid bare a hard almond-sized mass that dipped into the inguinal canal to about one-half its length. The canal was laid open and the mass was dissected out. It appeared like a fibrous neoplasm and not until it was sectioned could the existence of paraffine be determined. Connective tissues had penetrated throughout the mass. The paraffine had been broken up into minute particles which were confined in small cellular spaces. No paraffine was found in the hernial sac. The usual radical herniotomy followed.

CASE VII—J D, aged forty, mechanic. Presented himself at the afternoon consultation hour. He stated that he had been treated eighteen months previously with paraffine injections for the cure of a right-sided inguinal hernia. On examination a large, hard, oblong mass, beginning at the pubic tubercle and extending outward to the iliac spine, was found. The individual was rather corpulent. The paraffine mass appeared to be in rather loose adipose tissue. There was much pain in the inguinal canal, but a loop of intestine could not be felt because it was overlaid by the paraffine.

*Operation*—Under ether anæsthesia a long incision extending from the anterior superior iliac spine to the pubic tubercle was required to expose the large mass of paraffine. None of it had entered the inguinal canal. It was spread over the external ring, permitting the descent of an intestinal coil. The entire mass of paraffine after its removal weighed eleven ounces and was introduced at five different sittings. The mass was found in several large compartments with no adhesions except at the internal ring where connective tissue had evidently penetrated the mass. The usual herniotomy (Ferguson imbrication) was done. Recovery prompt.

CASE VIII—M D S, age twenty-one, brakeman, came to the Methodist Episcopal Hospital. He stated that he had undergone the paraffine treatment for hernia nearly two years previously. He was not certain whether his hernia was cured on account of the swelling due to the paraffine. He stated that he had almost constant local pain

Examination disclosed a rather flat, round, hard, oblong mass twice the size of a silver dollar. It was located intradermally and immediately beneath the papillary layer in the subcutaneous connective tissues. It was not attached to the deeper structures. Beneath it could be felt a protruding intestinal loop.

*Operation*—The skin incision passed through the hard mass. It was found that the entire mass was permeated with connective tissue, the paraffine could not be separated, but it was necessary to excise the skin and all like a neoplasm. No paraffine was found in the inguinal canal. A radical herniotomy concluded the operation.

CASE IX—T. B., aged twenty-four, farmer, presented himself with three rounded, walnut-sized masses in the right inguinal margin. One mass rested slightly above another to the outer margin and the third below the external inguinal canal, and, posterior to all of these masses, protruded an intestinal loop which was painful and tender to touch. It receded with recumbency. About fifteen months previously three injections of paraffine had been made, all at the same sitting.

*Operation*—The usual incision exposed three paraffine nodules inclosed in fairly circumscribed connective tissue inclosures. They had formed no cellular attachments and were easily lifted out of their beds. None of these lumps had exerted the least pressure on the external ring or any part of the inguinal canal, nor was there a particle of paraffine in the inguinal canal. The shots had missed the target entirely. The usual radical herniotomy concluded the operation. Recovery uneventful.

CASE X—J. L., real estate dealer, aged forty, came to the Methodist Episcopal Hospital to be operated for a right-sided inguinal hernia which had been unsuccessfully treated with paraffine. He stated that eight years previously he had received two injections of paraffine. Only a short time afterwards he felt a recurrence. He could plainly feel an intestinal loop in the scrotum when he assumed the upright position, and it usually disappeared when he lay down. But occasionally it was reduced with difficulty.

On admission a hard mass the size of a hen's egg could be palpated in the right groin immediately internal to and beneath the external ring. Behind this mass a reducible swelling was palpable. An incision revealed an ovoid smooth paraffine mass which was easily removed. Another mass could be felt behind the cord. This mass was oblong, nearly three inches long, and nearly one inch in diameter. It occupied a cavity with smooth walls and was easily taken out. The hernial sac and the cord passed between the two masses. There were no adhesions in the sac. The operation was finished by the Ferguson-Championniere method. Recovery per primam.

One cannot but wonder why the paraffine method for the treatment of hernia has survived. The foregoing cases would seem to demonstrate the inefficiency of the procedure. One can easily see the reasons for failure in the cases where injections had been made regardless of the anatomy and underlying conditions which constitute a hernia. But in several of our

cases the masses had been introduced at least partly in the inguinal canal and partly into the sac itself, and yet recurrences occurred. The reason for this is found partly in the fact that the inguinal sac was not completely obliterated and partly in the fact that the attenuated internal oblique muscle and the conjoined tendon were in no way reinforced or affected by the extraneous substance. Since it is impossible to determine the exact structural defects in any hernia without their exposure by incision, it follows that it is impossible to know where to deposit the paraffine and how much is necessary to reenforce the weakened tissues. It would seem that a so-called cure rested on a lucky chance. It is probable that cases of incomplete hernia with a short sac may be benefited by paraffine introduced into the inguinal canal producing its compression, but certainly no obliteration. Some of these so-called cures are deceptive as was shown by two cases who consulted the writer for other conditions. In both of these cases the individuals believed themselves to be cured. In both the paraffine masses were conspicuous under the skin and easily palpable by the patients, but they were unable to feel the intestinal loops beneath the paraffine nodules that could easily be palpated by the surgeon. Both of these individuals had been enthusiastic in their praise of the method and were the means of inducing many others to try the procedure. It would be instructive to examine a large number of these alleged cures to ascertain how many of them were carrying obscured hernias. It is more than probable that many of them are converted into concealed ruptures discoverable only by those trained and skilled in the diagnosis of these conditions.

# HYPERNEPHROMA IN THE FOLDS OF THE FALCIFORM LIGAMENT OF THE LIVER\*

By F N G STARR, M B. (TOR)

OF TORONTO, CANADA

ON January 24, 1917, I was consulted by a female patient, a spinster, aged thirty-five years. She complained of pain between the shoulders, extending up the back of the neck, sometimes severe headache. She had a sallow complexion, a weary expression of countenance, and looked much worn. The breathing was labored. There was a history of a gradual loss of appetite with flatulence coming on immediately after eating. The bowels were regular, she weighed 159 pounds. There was no menstrual disturbance.

A physical examination revealed a mass most prominent in the epigastric region, extending from the costal margin above to about four inches below the level of the umbilicus. There was dulness on percussion over the entire mass, and this was continuous on the right side with the liver dulness, which extended upward to the lower border of the third costal cartilage in front. There was resonance under the costal margin on each side and this continued down to Poupart's ligament. Between the lower end of the mass and the symphysis pubis there was also resonance. As indicated in the diagram (Fig 1) the growth extended a little more to the right than to the left. One could detect a definite though dull and slowly transmitted fluctuation wave. On palpation there was a distinct pulsation over the whole area. With the stethoscope one could hear a loud *brunt*, while to the right of the middle line, the *brunt* was not only loud, but crudely musical, resembling somewhat the noise of an express train passing through a closed station.

After an opaque meal the X-ray showed the stomach crowded well to the left side and vertical (Fig 2). It emptied on time. Renal function was normal.

The diagnosis lay between (a) an atypical pancreatic cyst, but there was no history of an injury, nor of frequent attacks of epigastric pain, nor was there the prostration that I have observed in the few cases that have come under my observation, (b) an hydatid of the liver was kept in mind, but the patient had always lived in Toronto and even in holiday time she had not visited sheep growing areas, the right lobe of the liver did not seem to be invaded but there was that "jelly-like" fluctuation that is described as almost characteristic, (c) a collection of fluid in the lesser sac due to a pathological closure of the foramen of Winslow came into one's mind, but there was no history of any intraperitoneal trouble that might give rise to such closure.

*Operation*—February 28, 1917. An incision was made a little to the left of the median line extending from the ensiform cartilage to a point half way between the umbilicus and the pubes, when an enormous

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\* Read before the American Surgical Association, May 31, 1917

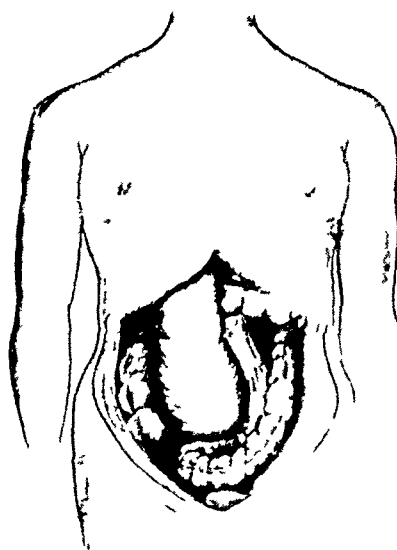


FIG 1



FIG 2



FIG 3



FIG 4—Low power

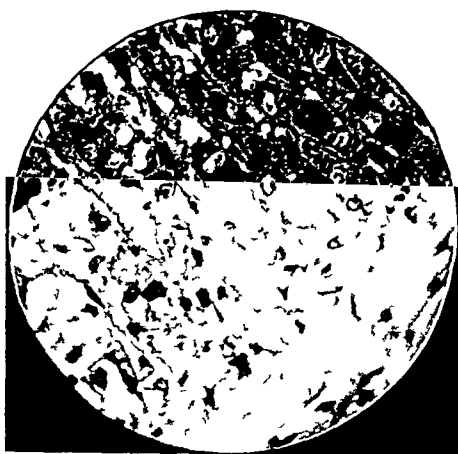


FIG 5—High power

## HYPERNEPHROMA OF THE FALCIFORM LIGAMENT

reddish brown tumor (Fig 1) presented in the wound, having across it a network of fine yellow lines. Had the growth been in the posterior mesentery or in the retroperitoneal tissue, one would at once have recognized its character from its appearance. It seemed to have a broad attachment above, and finally I discovered that it was between the layers of the falciform ligament, which were of course enormously stretched. By dividing this tissue close to the liver I was able to remove the whole mass without rupture.

As the growth was transferred to a basin, a forceps that was still attached caught on the basin and punctured the mass, some of its contents—thick grumous material—escaping into the basin. This made me realize the probable malignant nature of the growth. Consequently, in closing the abdomen I was careful to bring forward the cut edges of the falciform ligament and suture them together, along with the cut edges of the peritoneum, thus reconstructing the ligament and closing the peritoneal wound with the same suture. At the same time, should recurrence take place it is made easy of access, and the recurring growth would be extraperitoneal. The tumor weighed eight and a half pounds (Fig 3).

The patient has made an uninterrupted recovery, is now enjoying excellent health, and weighs 138 pounds.

Prof MacKenzie of the Department of Pathology reports.

The tumor in the gross, as received in the laboratory, is a large globular mass, about thirty centimetres in diameter. The main mass of the tumor is soft and breaks down at once when cut. It contains a large amount of blood and blood-clot, and when this is removed there remains a soft *débris* which contains a quantity of fat.

Towards the margin the tumor is firmer and of a yellowish tint, and the whole is surrounded by rather firm fibrous tissue, at one side are remnants of liver tissue, apparently outside the fibrous capsule.

The central area of the tumor is difficult to cut on account of the extensive hemorrhage and necrosis, but when sections are obtained the tissue is made up of large, rather polygonal vacuolated cells arranged as cords and columns about irregular blood sinuses. The vacuoles do not contain fat, although a good deal of fat is present as large droplets between the cells. On account of the fixation it is impossible to say whether there is glycogen in the tumor cells. The nuclei vary very much in size, but are large, with a large nucleolus and a relatively small amount of chromatin. Mitotic figures can be found but do not seem to be common. In places there is evidence of direct cell division. Towards the margin and more solid portion there is less fat and hemorrhage. The cells also seem more compactly arranged.

The most interesting point is that immediately within the fibrous tissue and among the tumor cells are a few cords of liver cells. Further in these cannot be found.

The fibrous tissue is not a true capsule but contains bile ducts and islands of liver tissue simulating an abnormal type of cirrhosis.

The general appearance of the tumor under the microscope more nearly approaches that of a hypernephroma than any other type, but the resemblance is not absolute (Figs 4 and 5).

On the other hand, it is difficult to understand the small areas of liver cords in the margin of the tumor within the capsule, and the possibility of a tumor



arising from the liver itself must be thought of. The general character of the cells, and especially of the nuclei, unquestionably suggests malignancy and the prognosis should certainly be guarded.

This condition must be exceedingly rare. Pepéré<sup>1</sup> reports a case of hypernephroma in the right lobe of the liver, but how adrenal rests can find their way between the layers of the falciform ligament is difficult to understand, especially when one remembers that the first traces of cortical substance do not appear until the embryo has reached a length of 6 or 7 mm, by which time considerable liver substance and the inferior vena cava will intervene between it and the falciform ligament, while the chromaffin tissue from which the medulla is formed does not appear until the embryo is about 15 to 20 mm.

As the right suprarenal ridge runs on to the dorsal surface of the liver, an aberration in its migration might result in some rests reaching the liver margin. Should it so happen that one of these rests be situated near the reflection of the falciform ligament and undergo a rapid proliferation, the line of least resistance would be downward between the peritoneal layers of the ligament.

It would be unwise for me to enter into a discussion of the histopathology as to whether these tumors really spring from adrenal rests or from the Wolffian body. This I shall leave to Dr. Louis B. Wilson,<sup>2</sup> of the Mayo Foundation, to whom I purpose turning over the material for further study in recognition of his masterpiece on hypernephroma.

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<sup>1</sup> Pepere. *Archiv de Med, Paris, Experimentale et d'Anat Path*, 1902.

<sup>2</sup> Louis B. Wilson. *Jour Med Research*, January, 1914.

# CHOLECYSTECTOMY

UNDER WHAT CIRCUMSTANCE SHOULD IT BE DONE?\*

BY MILES F. PORTER, M.D.  
OF FORT WAYNE, IND.

THE fearful fallacies that figures may lead to unless they be studied in connection with all related facts is nowhere more clearly shown than in the various papers, published in late years, on the relative merits of cholecystectomy and cholecystotomy. These papers likewise show how true it is that facts are quite as fallacious as figures.

Jones, for instance, in studying a series of his cases finds that he has secured 20 per cent more cures by cholecystectomy than by cholecystotomy, and Brown, by a little study, gets the same result, whereupon both Jones and Brown conclude that cholecystectomy is to be preferred to cholecystotomy. A comparison of Jones' figures with Brown's, however, shows that the former (Jones) gets 20 per cent more cures in both operations than the latter (Brown). The same logic used in arriving at a decision in favor of cholecystectomy would, if based upon a comparison of Jones' figures with those of Brown, lead to the conclusion that Brown should quit doing gall-bladder surgery and turn it over to Jones.

The writer felt impelled to make the foregoing remarks after a somewhat extensive study of the literature of gall-bladder and gall-duct surgery that has been published within the last decade—the results of which study are incorporated in another paper<sup>1</sup>. As a result of that study, coupled with a personal experience covering about 1000 cases of surgical disease of the gall-bladder and gall-ducts, the following conclusions have been reached:

1 The gall-bladder in man is a very important organ, though not a vital one.

2 Cholecystectomy is followed by an increase of bile pressure within the ducts and thus enhances the danger from pancreatitis.

3 The cause of the symptoms in so-called gall-bladder disease resides only relatively infrequently in the tissues of the gall-bladder.

4 Recurrence of symptoms after cholecystotomy means, in the majority of instances, overlooked stones, reformation of stones, infection of the bile stream, or hypercholesterinæmia.

Assuming that the first conclusion, *ie*, that the gall-bladder in man is an important organ, is concurred in, it necessarily follows that the gall-bladder should never be removed save when its removal is necessary for the cure of the disease for which the operation is done.

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\* Read before the American Surgical Association June 1, 1917.

<sup>1</sup> Journal American Medical Association, 1917.

The object of this paper is to discuss the question—When is the removal of the gall-bladder necessary?

It is generally agreed that gall-bladders of the following types would better be removed

- 1 Hydrops with obliteration of the cystic duct
- 2 Calcareous or fibrous degeneration
- 3 Chronic empyema
- 4 The cholesterol or strawberry gall-bladder
- 5 Carcinoma—provided it is limited to the gall-bladder
- 6 Extensive laceration or perforation

Many would perhaps add to this list gangrene of the gall-bladder. However, many patients with gangrene of the gall-bladder are desperately ill and will die if cholecystectomy, but will recover if a simple cholecystotomy and drainage operation is done. I have had several cases which support this position, as have Deaver and other operators. It may be said then that in cases of gangrene of the gall-bladder, cholecystectomy is the operation of choice only when it may be done without adding materially to the operative risk, and that all other cases of this kind should be treated by simple drainage. One occasionally meets with circumscribed gangrene due to pressure of a stone accompanied by acute cholecystitis. In many such cases cholecystotomy is to be preferred to cholecystectomy.

How about the acutely infected gall-bladder with thickened œdematous walls?

It is the author's experience that patients with gall-bladders of this type are practically always completely and permanently cured by cholecystotomy. In a hundred or more cases of this type I know of none that have recurrence of trouble provided at the time of operation or within a day or two thereafter there was a free flow of bile into the gall-bladder. Some of these patients were operated twenty or more years ago and are still living and well. Buchanan<sup>2</sup> states that of 212 cholecystotomized cases in which note of this fact was made he found that only 8.5 per cent of those in which it was noted that the bile flowed freely into the gall-bladder were not entirely cured, whereas in cases where the bile did not flow at all 45 per cent were not entirely cured. The prognostic importance of the flow of bile into the gall-bladder at the time of operation or shortly thereafter is at present, I think, underestimated. Attention to this point will often enable the surgeon to choose wisely as between cholecystectomy and cholecystotomy. That the gall-bladder has remarkable power of recuperation has been demonstrated many times.

Does the return of symptoms after cholecystotomy usually mean, as is held by some, that cholecystectomy should have been done?

My own experience and the study of the reported cases compel me to dissent from this view. In my own work cholecystectomy was done in 10 per cent. or less of all cases, and of this 10 per cent there was failure to

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<sup>2</sup> Surgery, Gynecology and Obstetrics Vol 21, page 504, 1915

get complete cure in two cases, whereas in the remaining 90 per cent there was failure of cures in five cases. In other words the failures following cholecystotomy were in proportion less than half those following cholecystectomy. There is no pretense that this calculation is based upon an exact tabulation of all cases, nor is it questioned that some failures in both types of cases have occurred without my knowledge. On the other hand, there can be no question but that in the writer's experience cholecystotomy has given a larger percentage of satisfactory results than has cholecystectomy. It goes without saying that malignant cases do not enter into this consideration.

Stanton,<sup>3</sup> who has presented one of the best studies of which I know on the subject of reformation of gall stones, says, "The reported cases do not bear out the assumption that cholecystectomy affords a much greater immunity against reformation of calculi than does cholecystotomy." My own experience is in accord with this. It is self evident that removal of the gall-bladder will not cure cholesterinæmia. Cases of this type, as has been pointed out by Aoyama,<sup>4</sup> Gerster,<sup>5</sup> and Rothschild,<sup>6</sup> are not in need of surgery at all, but are to be cured by a careful attention to diet, which consists largely in using only such foods as are poor in lipoids. It should be remarked in this connection, as was done by Gerster in his article previously referred to, that the hypercholesterinæmia may pass while the bile still contains a sufficient excess of cholesterol to produce symptoms, and that a persistent high cholesterol content of the blood strongly suggests common duct obstruction, especially if there are attacks of pain, and that the absence of jaundice proves nothing. It appears to the writer illogical to remove a gall-bladder in cases wherein the bile stream is infected except in those cases in which it seems clear that the infection comes from the deep structures of the gall-bladder—in interstitial cholecystitis, if you please. Rhoads<sup>7</sup> reports several cases which seem to show that the administration of hexamethylene-tetramine has a curative affect in bile stream infection. The average duration of drainage in 56 cases in which the drug was given was over six and one-half days less than in those in which it was not given. Rhoads also reports cases with recurrence of symptoms that were cured by the administration of this drug. One of the arguments advanced in favor of cholecystectomy is that the morbidity following this operation is less than is the morbidity following cholecystotomy. This is unquestionably true, but that it is true is in no small part due to the fact that a larger percentage of patients die, and that more promptly following cholecystectomy than following cholecystotomy. With this exception the writer's experience is that the increased morbidity of cholecystotomy as compared with cholecystectomy consists in the slight inconvenience caused by the bile drainage.

<sup>3</sup> ANNALS OF SURGERY, vol 61, page 226, 1915

<sup>4</sup> American Journal Medical Sciences, 1915, page 764

<sup>5</sup> Gerster, Progressive Medicine, June, 1916, page 164

<sup>6</sup> American Journal Medical Sciences, 1916, page 394

<sup>7</sup> Surgery, Gynecology and Obstetrics, October 1916, page 399

With the present state of knowledge the last word on the subject of the surgery of the gall-bladder and gall-ducts may not be said. However, at the present time the conclusion seems warranted that it is neither necessary nor advisable to remove the gall-bladder except when it is diseased or injured beyond the probability or possibility of restitution, and that this power of restitution may be presumed to be lost only when one or the other of the following conditions obtains

- 1 Hydrops with obliteration of the cystic duct
- 2 Calcareous degeneration or fibrous degeneration with contraction
- 3 Chronic empyema
- 4 The cholesterol or strawberry gall-bladder
- 5 Carcinoma
- 6 Extensive laceration or perforation
- 7 Gangrene other than localized gangrene, such as is sometimes caused by pressure of a stone

# ACUTE SUPPURATIVE CELLULITIS OF THE STOMACH<sup>1</sup>

WITH REPORT OF THREE CASES

BY EMMET RIXFORD, M D

OF SAN FRANCISCO

ACUTE suppurative cellulitis of the stomach, otherwise known as phlegmonous gastritis or gastric phlegmon, has long been known to pathologists, and occasionally has been met with by surgeons in exploratory abdominal operations. It is commonly reckoned as one of the rare affections of the stomach, for scarcely more than 150<sup>1</sup> cases in all have been reported. The increasing frequency, however, of publications of reports of cases during the last three or four years would seem to indicate that it is not so rare as commonly supposed.

In default of diagnosis before operation or autopsy the few cases which possibly recover are lost, as are the many in which the cause of death has not been verified by autopsy. Doubtless, too, in many cases of carcinoma and chronic ulcer of the stomach infective cellulitis is the immediate cause of death, but, being in the relation of a secondary affection, if recognized, it is apt to be looked upon as merely a complication, and hence receives little attention, or it is put aside as a terminal stage of an otherwise fatal malady.

The earliest cases reported (Boiel, 1656, Sand, 1695, Lieutaud, cited by Schnarrwyler) were cases of localized abscesses of the stomach wall. Brinton (Lectures on Diseases of the Stomach and Intestines, 1859) gave an excellent description of the disease under the title "Suppuration of the

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\* Read before the American Surgical Association, June 1, 1917.

<sup>1</sup> In view of the almost invariably fatal outcome (only one case cited by Emge, in which a diagnosis was made, is said to have recovered spontaneously, and one, the case of Fritz Koenig (*Deutsche m Woch*, 1911) recovered following a prompt gastrectomy, the case of Bovee (*Am J Med Sci*, May, 1908), which was rather one of localized abscess of the stomach wall than of a diffuse phlegmon, recovered after evacuation of the abscess and drainage through an abdominal incision in spite of the fact that the patient was six months pregnant at the time and aborted soon after operation, of this case, however, no bacteriological examination appears to have been made) it is clearly the duty of everyone who has observed such a case to record it in order that the actual frequency of the affection, its nature, cause, manner of development, and clinical aspects may be better and more widely known, to the end that diagnosis may be made early, at least before operation or autopsy, and if the proper treatment be finally determined to be surgical that the surgical indications and procedure shall be clearly defined. At the present time gastric phlegmon is still little else than a pathological curiosity, though it is an affection of which a good many people die. A very considerable literature on the subject has been built up, and it has been a favorite subject for graduation theses of German medical students, in whose "Inaugural Dissertations" may be found excellent bibliographies as well as reports of cases from the German clinics. See the dissertations of Klaus Erlangen, 1857, Lowenstein (Keil, 1874), Reinking (Keil, 1890), Jacoby (Koenigsberg, 1900), Schnarrwyler (Basel, 1906).

Areolar Tissue of the Stomach," and suggested the name "suppurative linitis," thereby distinguishing this affection from "cirrhosis of the stomach," for which he suggested the name "linitis plastica," which we now call Brinton's disease or "leather-bottle stomach." Brinton described the affection as beginning with pain, burning sensations, thirst, persistent vomiting, followed by febrile excitement, which rapidly merges into prostration, which is associated with delirium and ends in death by coma in from forty-eight hours to a few days from the commencement of the attack.

He called attention to the occurrence in some cases of a "chain of small abscesses more or fewer of which have burst through correspondingly small and distant orifices in the mucous membrane," and stated that "in its circumscribed form it may inaugurate an ordinary ulcer," but that such a commencement of gastric ulcer is very rare, and he also remarked that the disease is related to pyæmia. But since Brinton's knowledge of the pathology of the affection was gathered from post-mortem examinations he speaks of the "rotteness" of the tissues of the stomach wall as being rather characteristic. He cites Dittrich (*Schmidt's Jahrbuch*, b 72, p 303, 1851), who made the observation, interesting in view of the subsequent determination of streptococci as the bacterial cause of the affection, that during an epidemic of puerperal fever in Prag many cases of suppurative inflammation of the submucous tissue of the stomach occurred, the stomach wall being sometimes more than an inch thick. Dittrich also called attention to the frequent occurrence of erysipelas in relation with such cases.

Lowenstein (*Inaug Dis*, Keil, 1874) collected 23 cases of gastric phlegmon, and gave credit to Heller in Kiel of having found cocci in such a case in that same year. In 1885 Sebiklon found streptococci in a case of gastric phlegmon. Since then many cases have been studied, and in practically all of them streptococci have been found, most frequently in pure culture, and where in mixed culture most commonly associated with staphylococci.

Doubtless the nature of the organism of infection together with the relative inaccessibility of the site of infection, the rapidity of its course, the difficulty of diagnosis, and the serious operative risk on account of the early depression of the patient and the practical impossibility of avoiding dissemination of the infection in the peritoneum, amply account for the high mortality.

It is also not unlikely that the persistaltic action of the stomach muscle and the churning action of respiration, as well as the act of vomiting, may favor spread of the infection through the loose cellular tissue between muscle and mucosa.

Clinically, gastric phlegmon is characterized by a sudden onset beginning with pain in the epigastrium, chill, burning sensation in the stomach not relieved by drinking fluids, early and persistent vomiting, fever which may be slight and rise gradually, but which has been known rapidly to reach 105 or 106, early prostration, tenderness most often to the left of the median line, leucocytosis, 10,000 to 20,000 with high percentage of poly-

## ACUTE SUPPURATIVE CELLULITIS OF THE STOMACH

morphonuclears, sometimes palpable gastric thickening making a diffuse tumor movable on respiration, often with congestion at the base of either or both lungs. This early stage is soon followed by hiccough, increasing prostration, muscular rigidity at first in the epigastrium, running pulse, cyanosis, cold extremities, sometimes diarrhoea followed by constipation and abdominal distention, evidences of profound sepsis and advancing peritonitis. If the patient lives long enough, portions of the gastric mucous membrane may slough and come away in the vomitus. Death ensues in from three to ten days.

The diagnosis is difficult, for the earlier symptoms are common to several affections.

Basal pneumonia is difficult to exclude, except by waiting, and this is fatal in gastric phlegmon. However, basal pneumonia is apt to be unilateral, marked by relative increase in rate of respiration, less marked epigastric tenderness, and absence of palpable tender tumor.

Hemorrhagic pancreatitis is quite as fulminating in its onset as gastric phlegmon, but commonly has a higher leucocytosis with less fever—often no fever at all.

Perforation of gastric ulcer is marked by a more sudden, even explosive, pain, followed almost at once by muscular rigidity over a rapidly increasing area.

Acute gangrene of the gall-bladder has right-sided symptoms, perhaps the history of attacks of cholecystitis or biliary colic, and often the distended gall-bladder can be felt.

If the matter of diagnosis be viewed from the standpoint of establishing indications for surgical intervention the problem is much simplified, for the surgical world is agreed that early operation offers much the best chance for the patient suffering from gangrene or perforation of the gall-bladder, perforation of a gastric or a duodenal ulcer, acute hemorrhagic pancreatitis, etc. Only in pneumonia is abdominal section likely to do positive harm, and here an opening made under local anæsthesia is not very dangerous and may be the only possible means of making a diagnosis by exclusion at a sufficiently early period. The other conditions are, of course, evident as soon as the abdomen is opened.

The cases are ordinarily divided into two groups, one in which the portal of entry of the infecting organism into the stomach wall is apparent, the other in which it is not.

Fink (*loc cit*) suggested the following elaboration of this classification.

- 1 Primary or "idiopathic" forms in which the cause is not demonstrable
- 2 Secondary forms. These further divided into (a) direct extension phlegmons, *e g*, from œsophagitis, (b) local secondary phlegmons, *e g*, those which follow carcinoma or an operation (also ulcer?), (c) metastatic secondary phlegmons in which infection of the stomach follows the infection of some other part of the body.

The frequency with which the so-called idiopathic or fulminating forms



follow streptococcal sore throat would seem to make distinction between the primary form and the metastatic secondary difficult to be determined in particular cases. Repeated blood cultures in a large number of cases would be of interest, but it is questionable whether they would be of determining value, because negative findings would be worth little, and in the event of positive findings one could not say that the blood streptococci did not come from the stomach lesion unless blood culture should prove to be negative in a large number of cases of primary gastric phlegmon.

The prognosis would seem to depend on the relative attenuation of the culture—the greater the attenuation the greater the probability of localization in a definite abscess of the stomach wall.

Since in erysipelas and other streptococcal infections the propagation of the bacteria through the tissues is greatly impeded by scar tissue, and even in the fulminating forms of gastric phlegmon, as said above, the infection does not pass the pyloric ring, one would expect the stroma of a carcinoma or the scar tissue of a chronic ulcer to offer an effective barrier against rapid diffusion of the inflammation. This would seem to be the case clinically, for there are many observations recorded of cases with multiple minute abscesses in the walls of a chronic ulcer, whether simple or malignant, and also in cases of chronic cellulitis of the stomach, as mentioned by Brinton (*limitis plastica*).

It would appear that gastric phlegmon secondary to extensive carcinoma or chronic ulcer of the stomach is less fulminating in its onset and development than the so-called primary cases where no soldering of the loose areolar tissue has taken place. Perhaps, too, the mechanical rigidity of the induration by preventing peristalsis tends to lessen the spread of the infection. It is interesting to note that the cellulitis quite uniformly ceases abruptly at the pyloric ring and at the cardia. This fact is exemplified by Cases I and IV of this report, and, *per contra*, the fulminating character of the inflammation in Case II, in which the ulcer was exceedingly acute, and Case III, in which there was no discoverable lesion, left no room for speculation as to the presence of any inhibitory influence.

It seems probable that in the great majority of cases the streptococci enter the stomach through some lesion of the mucous membrane, but localization in the cellular tissue of the stomach of blood-borne bacteria would seem to occur with some degree of probability, because it would be difficult otherwise to account for such cases as those reported by Dittrich (*loc cit*), where foci occurred in the retroperitoneal and perirenal connective tissue and beneath the skin in cases of gastric cellulitis. But these, again, are post-mortem findings.

Bassart<sup>2</sup> thought that the streptococci enter through the squamous epithelium at the cardiac orifice. In Case III of this report (fulminating, diffuse phlegmon) the inflammation appeared to be oldest near the cardia, for in this area alone was there a deposit of fibrin on the peritoneal sur-

<sup>2</sup> Corresp Bl f Sch Aerzte, 1912, p 421

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face of the stomach Cheinisse emphasized the occurrence of phlegmonous gastritis in infectious diseases, notably erysipelas, and Schwartz in infections of the tonsils Vasilewsky (Russky Vrach, 1915, abs, *J A M A*) published a typical case in which erysipelas spread to the mouth and pharynx, then to the œsophagus and stomach Lehnhoff recently (*J A M A*, March 31, 1917) reported a case in a man of sixty-three with acute sore throat, in whom, after six days, severe chill occurred with nearly continuous vomiting (not bloody), pain in left epigastrium, rise in temperature to 102, pulse 120 A dose of castor oil was given and was followed by large fluid evacuations, but the pain and epigastric tenderness were increased Operation performed to relieve the progressing peritonitis showed stomach covered with fibrin There was no ulcer and no cancer. The patient died twenty-four hours later

It is interesting to note that in this case, in spite of the extensive infiltration of its wall, the stomach responded to the stimulation of the cathartic

Other cases comparatively recently reported are those of Emge (*Tr Chicago Path Soc*, 1914), of Glascock and of Fink and Oliver (*Tr Chi Path Soc*, 1916, and *Bost M and S J*, November 30, 1916), and Tuxen (*Hosp tidende*, Copenhagen, August 2, 1916, v 59, No 31) See also Mintz (*Deutsch Arch f kl Med*), Lehnhoff (*J A M A*, March 31, 1917, v 69), and Adams (*Lancet*, 1910)

Emge's case occurred in a man of sixty-seven, while in Cook County Hospital for fractured clavicle Twelve days after entering he was suddenly seized with epigastric pain, an hour or so later he started to vomit profusely Examination revealed rigidity, tenderness, and tympany, temperature rose to 106, pulse feeble, death next morning Autopsy five hours later showed typical so-called primary gastric phlegmon, greenish pus exuding from cut sections of the stomach containing pure culture of streptococci, no primary focus detected Emge published an excellent photomicrograph of cross-section of the stomach showing the enormous thickening of the submucous connective tissue

Fink and Oliver's case was in a male aged fifty-eight, convalescing from operation, eleven days before, for double inguinal hernia, who developed suddenly symptoms suggestive of peritonitis in the upper abdomen, temperature 99, rising to 102, pulse 96 to 130 Operation showed the stomach thick The stomach was drained, but patient died eight hours later Streptococci were found, and no primary focus of infection was made out

Tuxen claimed that his case was the third on record in which the diagnosis was made before operation or autopsy The patient was a previously healthy young man under medical observation for measles when he was seized with sudden severe epigastric pain followed by persistent vomiting, paresis of the intestine, and high fever Operation established the diagnosis, the stomach was drained, but death followed in three days

Tuxen advises operation in suspected cases, but deprecates doing anything further if the diagnosis is verified.

Kemp (*Dis Stomach, Intest, and Pancreas*, 1917) advises laparotomy for diagnosis and relief if possible, if patient does not consent to operation, then the use of ice-bags to the epigastrium, rectal feeding, enteroclysis to relieve tympanites, proctoclysis for sepsis and thirst, opiates as necessary

For the purpose of determining therapeutic indications with the prognosis in view, it would seem that the cases should be divided into three roughly distinguishable groups

- 1 Cases with localized abscesses (the most favorable)
- 2 Cases with minute multiple abscesses in the presence of inhibitory induration
- 3 Cases of widely diffuse cellulitis (the least favorable)

In the first group the indication is clear—viz to open the abscess and drain. In the third group the indication is equally clear—to perform total gastrectomy without opening the infected areas if the patient is in reasonably good condition so that there is a chance of success, otherwise to close the abdomen without doing anything further in a surgical direction

In the second group the surgeon will be put to it to determine the best course to pursue—whether to do a partial or a total gastrectomy. If partial gastrectomy is done the line of section should pass far from the line of palpable induration and beyond any cedematous or reddened areas, for otherwise, as occurred in Case I of this report, the suture line will break down

Gastro-enterostomy would seem to be contra-indicated except as preliminary to a possible gastrectomy

In groups two and three drainage would seem to be useless unless it were mechanically possible to open the stomach in some uninfected area, or, if the cellulitis be diffuse, opening with a cautery knife and then slitting the mucous membrane in several places from within the stomach in order to make possible internal drainage, closing the wound in the stomach and draining the region with a gauze pack. I do not know of any such procedure having been attempted

Of the four cases here reported the first occurred in 1909, the three others in the winter of 1916–1917 during a period in which many physicians of San Francisco had under their care a rather unusual number of severe streptococcal infections, particularly streptococcal sore throats, protracted in their course and followed by many pyæmic and suppurative sequelæ

CASE I—Seen with Dr E Schmoll. Large, thin-walled carcinomatous ulcer with secondary cellulitis. Woman fifty-six years old, with history of long-standing indigestion without pain but with some discomfort, generally relieved by eating

About December 12, 1909, consulted physician for epigastric pain. There was local tenderness, slight rise of temperature. A week later

## ACUTE SUPPURATIVE CELLULITIS OF THE STOMACH

after catharsis palpable thickening was made out above and to the left of the navel, movable on respiration, no muscular spasm, leucocytes 12,000 to 15,000, temperature 100 to 101, very little depression

December 22 Temperature 102, leucocytes 19,000, tenderness more marked Operation advised

December 23 Leucocytes 24,200 Operation Median incision Stomach found contracted, vessels on its surface engorged, many enlarged bright-red lymph-glands in lesser omentum, a few in greater omentum The palpable tumor was the thickened posterior wall of the stomach, but the anterior wall was also somewhat thickened in the region of the pyloric antrum Lesser peritoneal cavity free, no adhesions, but posterior wall of stomach was covered with fibrin The stomach after washing was opened The posterior wall was the seat of an enormous ulcer The distal three-fourths of the stomach was then removed, the section being made well beyond the line of palpable induration and apparently in normal tissue Union with the duodenum, which was long, as in Billroth gastrectomy No 1 The operation, which lasted nearly two hours, was well borne, pulse was under 110 when patient left the table

December 24 Pulse gradually rose to 140 in the afternoon without rise in temperature, patient was given fluids by rectum The condition gradually improved till December 27 Patient was then allowed water by mouth Temperature 99, pulse 120 to 130, respiration 30

December 30 Tumefaction beneath suture line, stitches removed

December 31 Great amount of seepage, stomach evidently perforated, no peritonitis

January 2 Several sloughs of stomach wall came away through the open incision Patient fed by catheter passed down duodenum, digestive fluids regurgitated into wound

January 7 Severe hemorrhage from region of pancreas, repeated in the night

January 8 Patient died, seventeenth day after operation and twenty-eighth after onset of inflammatory symptoms

The pathologist, Dr Ophuls, reported on the excised portion of the stomach as follows

Large flat ulcer with fairly clean, smooth floor and indurated base Edges elevated and infiltrated with soft, greyish tumor which extends near to the edge of the specimen and in one place apparently beyond In the tissue at the base and along the margin of the ulcer there are many bright yellow miliary abscesses The tumor is typical adenocarcinoma

Commenting on this case, I would say that it was much less fulminating in its development than most such cases, perhaps because of the resistance offered to the dissemination of the streptococci by the contracting stroma of the tumor I believe the prognosis would have been better had total gastrectomy been performed instead of so extensive a partial gastrectomy, this because of the difficulty of defining the limits of the carcinoma and of the cellulitis, especially also because the duodenum was long and would readily have reached the cardia Culture should have been made.

CASE II—Stanford Service in San Francisco Hospital *Acute hemorrhagic ulcer with cellulitis* Man fifty-four years old, white, single, brought to hospital August 29, 1916, vomiting blood, temperature 101.2, pulse 84, respiration 20, apparently in desperate condition, able to give but a meagre history. Heavy drinker for years, drank mostly beer, less during last year. Digestion good until within one month, when he began to have occasional burning pain in abdomen, vomited occasionally, lost 25 pounds in weight, for the last week vomited blood frequently, and rapidly became weak and short of breath. No food retained during last two days, taking food seemed to have no effect on the burning pain. Blood-pressure 150-100 mm.

August 30 Vomited large quantity of blood in early morning. Blood-pressure 100-80, hæmoglobin 60 per cent, leucocytes 31,000. Abdomen tender all over, most in upper right quadrant. Diagnosis, acute ulcer of stomach with peritonitis.

*Operation*—Nitrous oxide, a little ether. Midline incision in epigastrium, indurated, inflamed area 6 cm. in diameter in greater curvature, hypodermic needle brought pus from thickened area, resection of distal half of stomach, posterior gastro-enterostomy. Duration of operation, one hour and a half, patient very weak, salt solution under skin, camphorated oil, etc. Death four hours after operation.

Dr. Ophuls described lesion in excised portion of stomach as hemorrhagic necrosis of stomach wall 3 cm. in diameter, surrounded by phlegmonous inflammation, smear showed few diplococci, Gram +, culture, pure growth of streptococci.

Autopsy findings chiefly negative as bearing on the etiology of the gastric phlegmon, small amount of bloody fluid in right pleura, terminal bronchopneumonia. Tonsils atrophic, but smears from them showed many Gram + diplococci and other bacteria, cultures many diplostreptococci and few of staphylococcus aureus. Heart valves showed no bacteria, lungs, long chains of streptococci.

CASE III—*Diffuse fulminating phlegmon following sore throat*  
Seen with Dr. Adler

Woman aged forty, single, domestic, strong, hearty, hard working, general health good save only for an occasional bilious attack, which led her to take a great deal of Pluto water.

December 22, 1916 Caught cold, took a dose of aspirin.

December 26 Not feeling well, took castor oil, vomited, and then had great abdominal pain, the bowels moved.

December 27 Vomited all day. Enema brought little result.

December 28 Tried to go to work, but soon had to give up, then consulted the physician. Temperature 99. Vomited several times, unable to take food. Shortly after noon had severe pain exactly in the midline, not radiating, epigastrium soon becoming tender, a little cough, especially on taking deep breath. Complained of feeling very tired, slight cyanosis.

4.30 P.M. Temperature 102.6, respiration 36, leucocytes 10,200, polymorphonuclears 98 per cent. Slight resistance in epigastrium, borborygmus absent, sticky râles at bases of both lungs.

## ACUTE SUPPURATIVE CELLULITIS OF THE STOMACH

8 00 P M Cyanosis slightly increased Patient said she felt better, but apparently the process in the bases of the lungs had increased. Tenderness pronounced and sharply localized in midline below xiphoid, occasional hiccough, pulse 100 to 110 Blood-pressure 110, leucocytes 14,700, polymorphonuclears 98 per cent Urine dark, nearly solid on boiling

Diagnosis lay between basal pneumonia, acute pancreatitis, and gastric phlegmon The process in the lungs was bilateral and did not seem extensive enough or pronounced enough to account for the great prostration or the local tenderness, and pancreatitis in cases with such prostration is apt to give a higher leucocytosis with less fever

Exploratory operation Midline incision under local anæsthetic showed considerable free fluid in the peritoneum, stomach thick, feeling like a great slab of liver an inch thick Patient complaining of pain, was given a little gas and oxygen and ether, incision enlarged, stomach seen deeply congested, thickened from pylorus to cardia, lymph-glands in omentum large and red, much fibrin on anterior wall of stomach near cardiac end The posterior surface of the stomach presented the same picture A hypodermic needle brought muddy pus from the stomach wall, incision showed the muscle thick and œdematous, submucous connective tissue much thickened, necrotic and full of pus Stomach opened Interior was fiery red A small portion of stomach wall was excised for examination Stomach showed no power of contraction, it felt inert, heavy, lifeless Multiple drains were inserted and the wound closed Cultures and smears showed streptococci in pure culture Death twenty-four hours later

Autopsy one hour after death No microscopic evidence of peritonitis, but smears from areas near the stomach showed streptococci, no bacteria in smears from cut surfaces of liver, spleen, kidney, or pancreas The inflammatory process (swelling and suppuration) of the stomach wall was sharply limited at the pylorus and at the cardia, pancreas normal, lungs showed simple congestion at the base, liver, a moderate degree of fatty degeneration, kidneys, a few areas of cellular infiltration in the cortex

When the stomach was laid open careful search failed to show any discoverable lesion of the mucous membrane

# A METHOD OF GASTRO-ENTEROSTOMY

BY FRANCIS T STEWART  
OF PHILADELPHIA

If there are signs of gastric retention the stomach is emptied by lavage shortly before the operation

The posterior wall of the stomach is exposed, as in the ordinary operation of retrocolic gastro-enterostomy, by tearing through the mesocolon. A celluloid suture is passed through the posterior wall of the stomach at or near the greater curvature, and through the antimesenteric border of the jejunum several inches from the duodenojejunal juncture. Upward traction on this suture causes the stomach and the intestine to fall together. A second suture then unites the apposed viscera at a point two inches from the original suture, *i e*, two inches nearer the duodenojejunal juncture. The distance between the sutures may, of course, be less or greater according to the judgment of the surgeon. The first suture is drawn towards the patient's shoulder, the second towards the patient's right hip, thus lifting the parts to be anastomosed from the abdomen and bringing them into taut alignment. These sutures may be confided to an assistant or kept tense by attaching to each a pair of heavy forceps. The line of contact between the stomach and the intestine is now made permanent by a continuous seroserous suture, extending from the lower guide suture to the upper guide suture, and tied at the latter point, the end, however, being left long for use during the final step in the anastomosis (Fig 1)

After shielding the general peritoneal cavity from contamination by means of an encircling gauze pad, the peritoneal coat of the stomach is incised close to and parallel with the line of suture, thus exposing the blood-vessels which, with a small bite of the underlying mucous membrane, as yet unopened, are secured with hæmostats at each edge of the incision (Fig 2). The number of hæmostats required varies with the length of the incision and the vascularity of the part. The average is from five to six on each side of the incision. A smaller number is shown in the illustration for the purpose of clarity. The mucosa is incised between the rows of forceps, thus opening the stomach. Additional hæmostats may be needed to control minute vessels which could not be seen before the incision into the stomach was made. A gauze pad is laid over the gastric incision, and the row of forceps nearer the intestine reflected on to the gauze. In the same way as in dealing with the stomach the outer coat of the intestine is incised, the vessels caught with hæmostats (Fig 3), the mucosa opened, and the opening covered with a gauze pad. This leaves the posterior wound edges exposed.

Each pair of vessels (one gastric vessel, one intestinal vessel) in these

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\* Read before the American Surgical Association, June 1, 1917

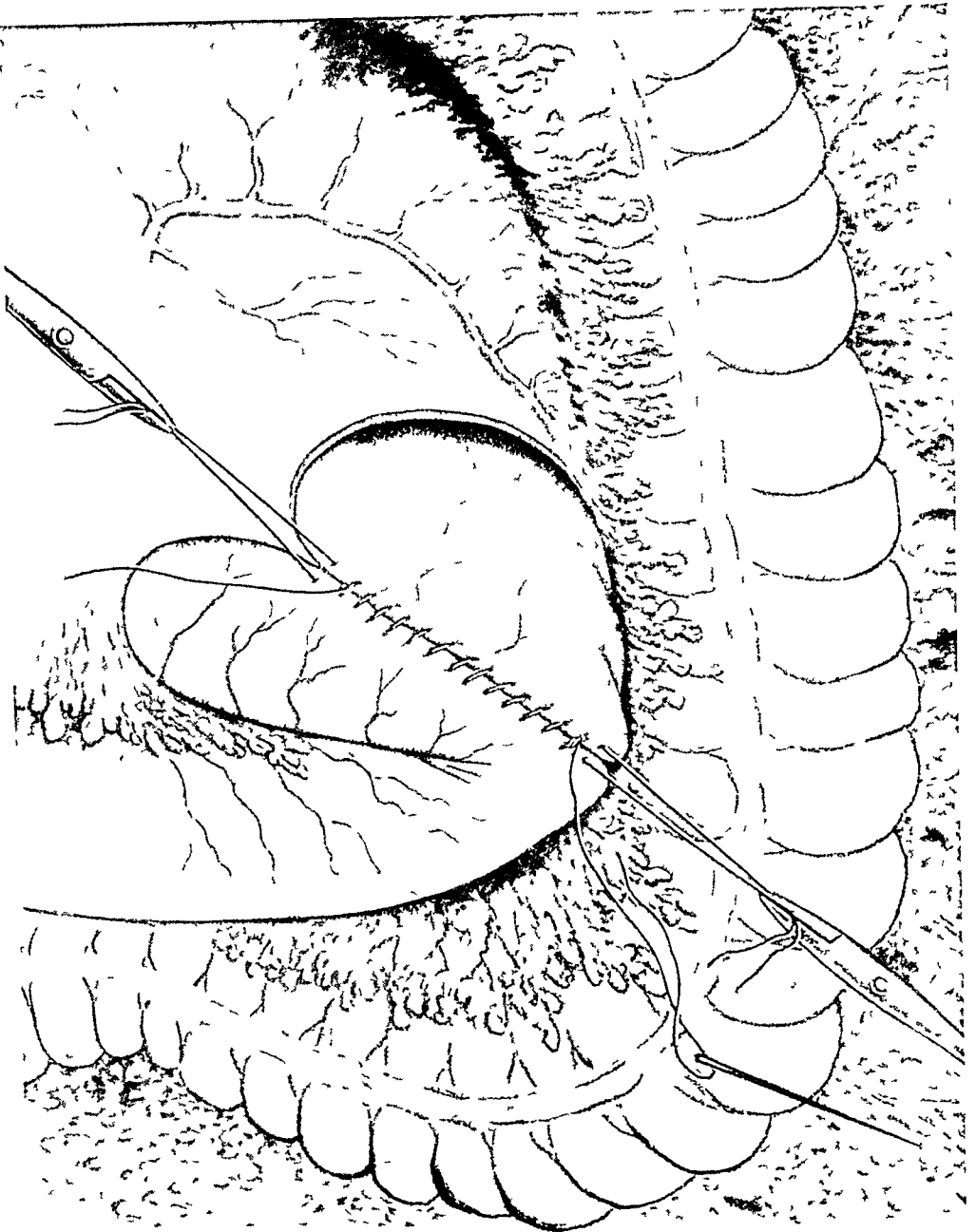


FIG. 1.—Gastro-entrostomy, showing the two guide sutures and the primary seroserosus suture



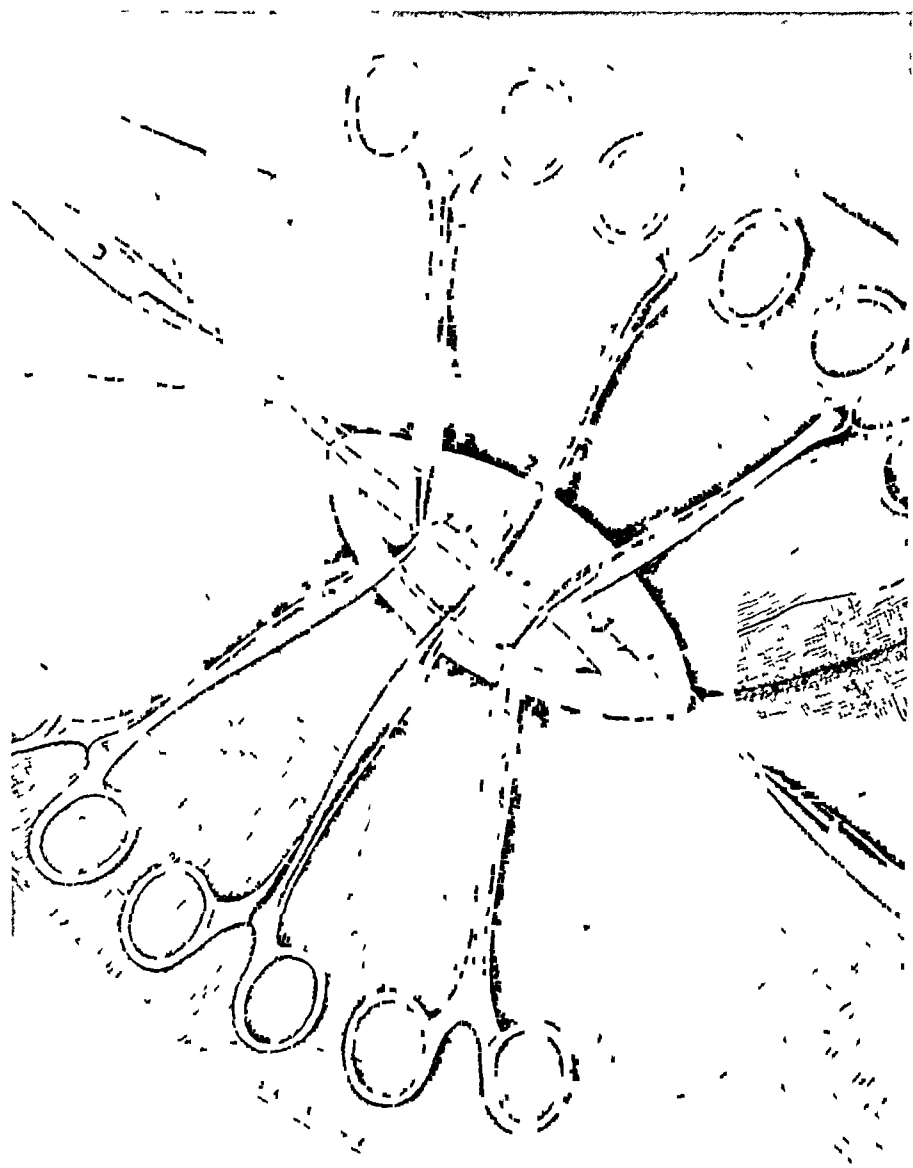
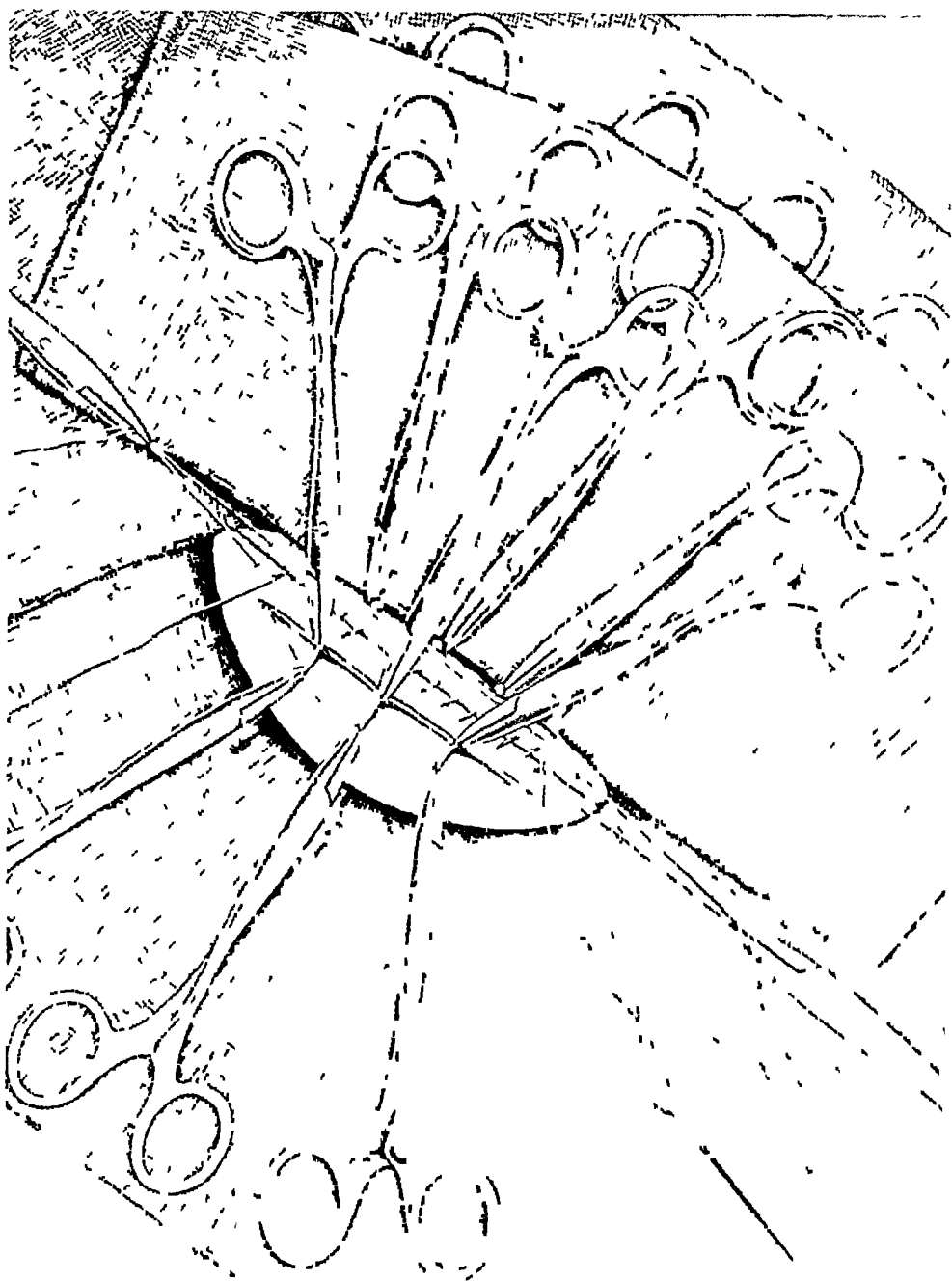


FIG. 2.—Gastro enterostomy, showing forceps applied to the gastric vessels

FIG. 3.—Gastro-enterostomy, showing forceps applied to the intestinal vessels



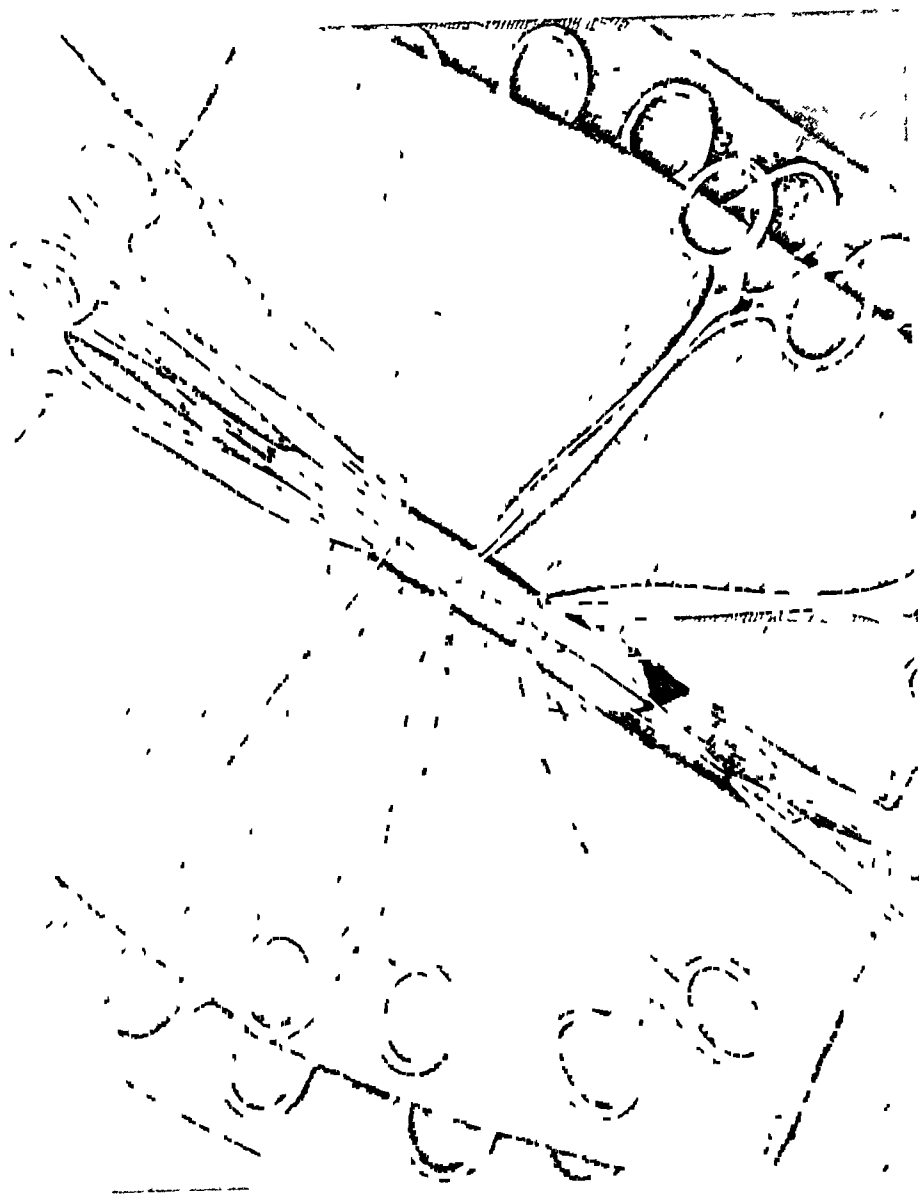


FIG 4—Gastro enterostomy showing the method of ligating the posterior vessels and wound edges

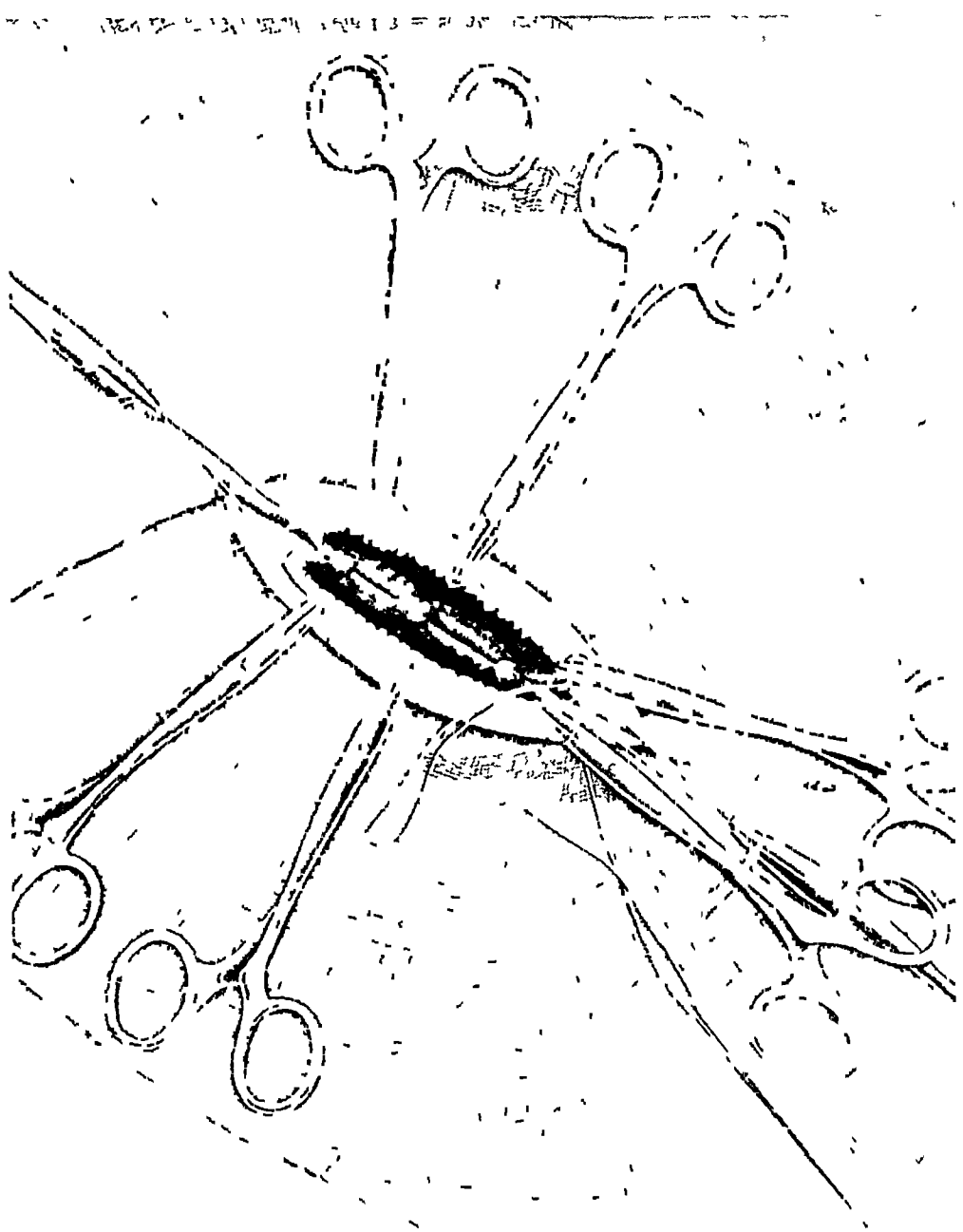


FIG 5—Gastro-enterostomy, showing the method of ligating the anterior vessels and wound edges

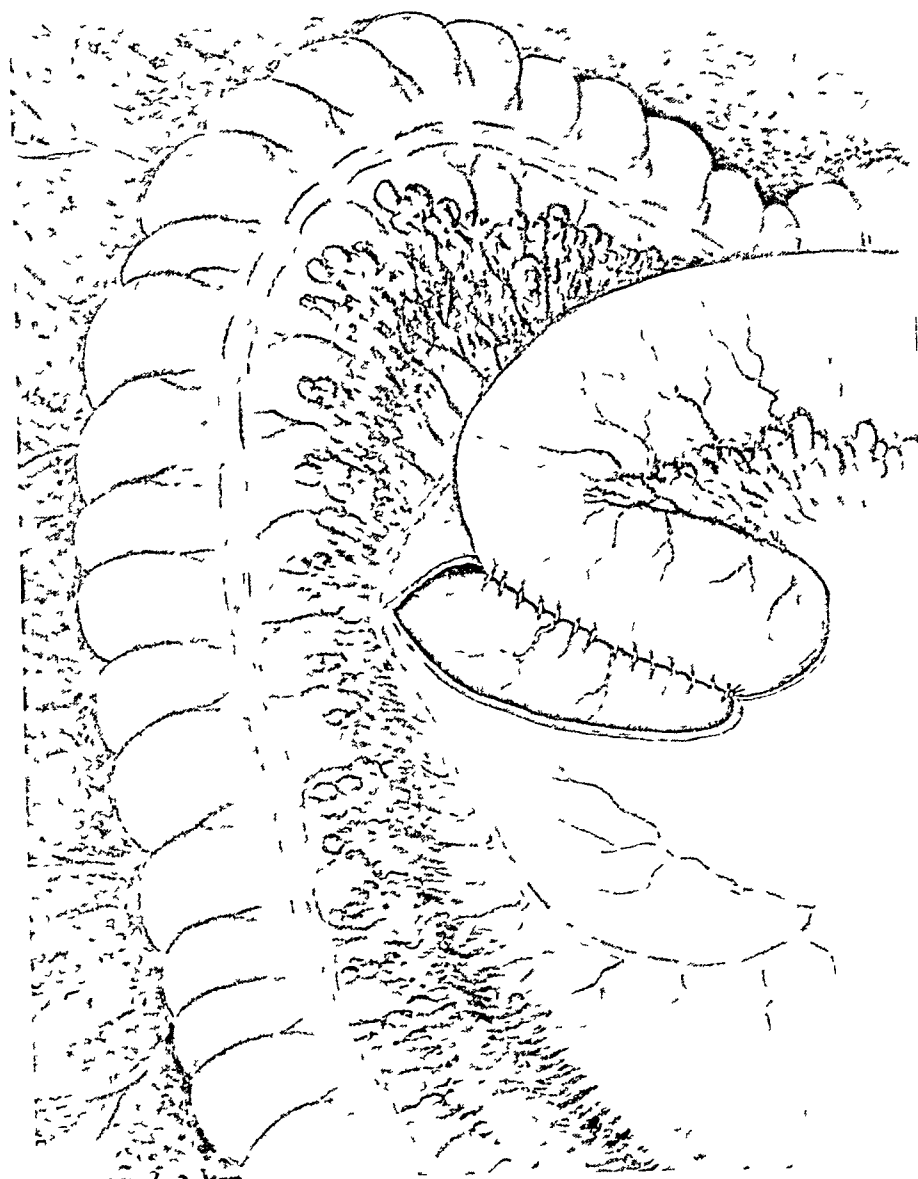


FIG 6 —Gastro enterostomy, operation completed by the anterior seroseros suture

exposed edges is ligated with a single strand of chromicized catgut, after drawing the edges together by means of the two forceps (one on the stomach, one on the intestine) in closest proximity (Fig. 4). These ligatures not only prevent bleeding but also hold the edges in firm apposition. If a hæmostat does not stand in close relationship with a fellow, an additional forceps may be employed to establish this relationship.

After removing the gauze pads which lay over the gastric and the intestinal openings the anterior edges of these openings are drawn together by ligatures, beginning at the end farthest from the surgeon. The two forceps which lie opposite each other are held by an assistant. The right end of the ligature is passed around the forceps on the intestine from right to left, the left end around the forceps on the stomach from left to right, thus the ends emerge between the forceps, beneath the loop of ligature (Fig. 5). The forceps are brought parallel to the long axis of the wound, rolled toward each other, thus inverting the mucous edges of the wound, the ligature tied, and the forceps removed. Each succeeding pair of vessels is dealt with in a similar manner. The result is the same as with the posterior wound edges, *i e.*, hæmostasis is assured and the edges are bound firmly together.

The rest of the proceeding is much like that usually followed. The sero-serous suture is continued along the anterior portion of the anastomosis and tied at its point of origin (Fig. 6). The margins of the rent in the mesocolon are fastened to the stomach or the intestine.

The operation described above is easier to perform and less dangerous than gastro-enterostomy in which clamps are employed.

After the first guide suture has been inserted the structures to be joined are already in juxtaposition and there is no risk, even for the beginner, of confusing the relations of the parts, such as is possible during the application of clamps and their subsequent adjustment. Among the unreported disasters following gastro-enterostomy there are no doubt some which, thanks to inexperience and clamps, result from suturing the lower end of the intestinal opening to the upper end of the gastric opening. One of the stated advantages of clamps is that they steady and hold together the concerned viscera. As a matter of fact the stomach and the intestine are necessarily separated by the intervening blades of these instruments, whereas guide sutures not only permit direct apposition but at the same time create a ridge at the line of contact which facilitates suturing. The same degree of close alignment is obtained for the anterior sero-serous suture, after the anterior wound edges have been inverted by ligatures. When clamps are employed the mucous membrane pouts, being squeezed out by pressure, and is usually excised. This excision is not needed in the operation without clamps. Suturing of the anterior edges of the mucous membrane, even after the clamps have been rotated toward each other, is more difficult than the application of ligatures as described above. Further, one draws less stomach and less intestine from the abdomen

when using guide sutures instead of clamps, or, to put it in other words, a longer anastomosis can be made with the aid of guide sutures than can be made with the same amount of stomach and intestine when clamps are employed, a consideration which occasionally is of some importance

The danger of leakage of gastric or intestinal contents during the operation is no greater, perhaps even less, than when clamps are applied. Contusion or crushing of the tissues in the immediate vicinity of the anastomosis is avoided. Damage of this nature is potent for evil, especially in the old, the arteriosclerotic, the cachectic. The possibility of clamp injury predisposing to peptic ulcer of the jejunum, or causing necrosis at the site of anastomosis, although remote, is nevertheless real, and must be included in the evidence against the clamp. The greatest menace, however, is that of bleeding after the clamps have been removed. Like a tourniquet, the clamp increases the tendency to oozing of blood, after the removal of the compression, and when clamps are employed in gastro-enterostomy the hemorrhage, if all the severed vessels have not been closed, remains undiscovered until the patient vomits the blood or presents evidences of acute anæmia. One is then confronted with the alternative of waiting hopefully, or of reopening the abdomen, during a critical period, in order to arrest the bleeding. Even carefully applied sutures are uncertain, so far as hæmostasis is concerned, unless the wound is inspected after the clamps have been removed, since even large blood-vessels, unseen because empty, may readily be punctured by the needle. In the operation reported in this paper the surgeon ties all the open blood-vessels, and may assure himself that hæmostasis is complete. Of the 40 patients upon whom this operation was performed 38 recovered without mishap. Two, both afflicted with inoperable carcinoma of the stomach, died of exhaustion and pneumonia, one on the sixth and one on the seventh day.

# A SIMPLE METHOD OF RESECTING THE TRANSVERSE COLON

WITH PRESERVATION OF THE OMENTUM LIKEWISE FOR THE SUSPENSION OF A PROLAPSED COLON\*

BY JOHN E. SUMMERS, M D  
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It is not the purpose of this paper to presume to offer anything original, but rather to emphasize the value of a procedure apparently too little appreciated by surgeons, if one is to judge from observations of their clinical work, and from journal and text-book publications

Resection of the transverse colon when done for other than malignant diseases, as for example, redundancy and ptosis, sacrifices the omentum, thus leaving uncovered peritoneal surfaces, difficult to protect without disturbing relations of viscera which had better be left alone. I am familiar with the work of Lardennois and Okinczyc and its still further elaboration by Pauchet, in which they make use of the clinical fact that the omentum can be easily and safely separated from the transverse colon and its mesentery up to the lower border of the stomach, widely opening the lesser cavity of the peritoneum if desired. Thus, all of the posterior wall of the stomach, that also of the first part, and of the upper portion of the second part of the duodenum is exposed the pancreas is also exposed. Prof Pauchet published a most interesting illustrated article in *Bulletins et mémoires de la Société de Chirurgie de Paris*, May 10, 1916. An excellent and favorable criticism and reproduction of this was published last fall by Dr Sherwood-Dunn of Paris, in the *American Journal of Surgery*. The technic admits of ready exposure and surgical intervention upon all of the parts exposed when they may be the seat of trauma or disease. The separation of the omentum from the transverse colon and the transverse mesocolon depends upon the anatomical arrangement and relationship of the peritoneum. A bloodless, loose, and what I designate a *peritoneal ligament*, is formed along the upper border of the transverse colon by the juncture of the layer of peritoneum covering the stomach anteriorly and the omentum both anteriorly and posteriorly, with that enveloping the transverse colon the latter goes posteriorly to cover the transverse mesocolon,—anteriorly forming the posterior layer of the lesser peritoneal cavity, spreading out below into the posterior layer of the greater peritoneal sac. The technic of resection of the transverse colon advocated is carried out after an X-ray study of the relative positions of the hollow viscera. A liberal incision having been made, the bowel is delivered and made taut by assistants. The operator lifts up the omentum with one hand sufficiently to recognize the line of juncture of its under surface with the upper surface of the colon. With a sharp pointed knife (a straight bistoury preferably) the peritoneum is nicked along this ligamentous line to the desired extent of resection. With a gauze sponge

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\* Read before the American Surgical Association, May 31, 1917



the omentum is freed upwards from the transverse mesocolon to the lower border of the stomach, exposing but not injuring the mesentery blood-vessels. The resection of the colon is then done in the usual manner, being facilitated by an accurate view *from above* of each blood-vessel in the mesentery. After the completion of the anastomosis, end to end, or lateral, the omentum is made to cover the line or lines of suture of the anastomosis in such a manner as indicated in the particular case, and otherwise to resume, as far as practicable, its protective position. My personal experience with this technic leads me to favorably recommend it in non-malignant disease. Lardennois makes a colectomy by first separating the omentum as I have described for resection of the transverse colon, then going to the left he divides the avascular suspensory peritoneal band (the suspensory splenic ligament), dividing then the outer peritoneum as is usually done in mobilization. Practically a like manipulation is done on the right side, the bowel being mobilized is resected in the usual way. Binnie's *Operative Surgery* is the only book in English in which there may be found a description of this excellent and safe operation of colectomy. In a number of instances during the past year I have employed a technic for the correction of prolapse of the transverse colon based upon the Lardennois-Okinczyk-Pauchet studies in clinical anatomy. None of the operations commonly advocated for this purpose have been satisfactory to me. What I am now doing seems to promise well,—there have been no ill after-effects. It consists in opening the lesser cavity of the peritoneum as described, suturing the transverse colon to the posterior wall of the stomach along the line of its greater curvature, thus practically placing the transverse colon in the lesser peritoneal cavity, then dropping the omentum forward. In several instances in which the hepatic flexure was not properly fixed by this technic, I have brought up a piece of omentum to the right of its detachment from the colon, and after ascertaining by upper and outward traction the proper position of the flexure, have sutured this omentum to the parietal peritoneum. This lifting of the hepatic flexure might be accomplished from behind by a retroperitoneal incision fastening the so-called nephrocolic ligament to the lumbar fascia. When the position of the stomach has appeared to require, I have in addition done a gastropexy.

Of course the few months' trial of this technic can to date only be suggestive.

# CARCINOMA OF THE SPLENIC FLEXURE OF THE COLON<sup>1</sup>

BY JOHN A. HARTWELL, M.D.

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THE problems presented by six cases of carcinoma of the splenic flexure of the colon or its immediate proximity were so difficult of solution that the writer was led to make an extended study of the subject. The lack of success of many others in solving these problems coincides so exactly with his own, that it seems proper to ask the attention of the Association to them, in the hope that the discussion may yield some measure of improvement in dealing with them. While there is found some encouragement in the literature, the complete story shows that cancer at the splenic flexure has proved to be a peculiarly fatal lesion. The record of the six cases observed is as follows.

CASE I.—J. C., male, age twenty-seven, admitted to the hospital May 6, 1913, suffering from a well-developed intestinal obstruction of six days' duration. The pain seemed to centre in the right lower quadrant. The only cause worthy of consideration from a study of the history and the abdominal examination, was that of constricting bands at the cæcum, as a sequela to an interval appendectomy, done two years previously. An incision was made over the cæcal region. A band passed across the cæcum from the omentum outward to the abdominal wall, and the pressure exerted had been so extreme, that the entire caput coli had sloughed away. The ileocæcal orifice presented. The peritoneum contained several quarts of fluid fæces. This was thoroughly washed out, and the cæcum drawn into the wound by stitching the free edges to the peritoneum and skin. Recovery was unexpected, but gradually took place. Many weeks had to be spent in getting the patient into condition to deal with the open cæcum. When this was undertaken, it was discovered that the true cause of the intestinal obstruction was a constricting cancer, just distal to the splenic flexure, and the band across the cæcum was secondarily responsible for its destruction. A lateral ileosigmoidostomy was done, with an excision of the cæcum and the ascending colon, the free ends of the bowel being closed. The patient steadily gained after this operation, and four months later the cancer with the remaining portion of the colon was removed. It was noted that the closed end of the sigmoid, proximal to the anastomosis, had developed a well-marked cæcal pouch. When last seen, nearly two years later, he was dying of general peritoneal carcinosis.

The study of the tumor showed it to be a mixed scirrhous and colloid carcinoma. The growth completely surrounded the colon, and closed

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\* Read before the American Surgical Association, May 31, 1917.

its lumen At one point there was a perforation in the base of an indurated villous-like ulcer, but no abscess had developed

CASE II—E B, female, age thirty-five, admitted to the hospital July 17, 1913 Twelve years earlier she had had a double oophorectomy for excessive dysmenorrhœa She remained well for eight years Then she began to suffer from abdominal pain, of a recurrent type, which seemed to centre about the cæcum A diagnosis of chronic appendicitis was made, though a late manifestation of peritoneal adhesions was considered The attacks were very infrequent, and not severe enough to call for operation until a week or two before admission to the hospital From that time, however, they had progressed markedly, and nausea with vomiting was present

At the time of admission, the patient was at the height of an attack, and demanded immediate operation because the pain had grown so severe in the preceding twelve hours The physical examination gave no farther evidence of the seat of the trouble than could be obtained from pain and tenderness over the cæcum A median laparotomy was done, because of the doubtful diagnosis A slightly inflamed appendix was removed Exploration revealed a hard encircling cancer just beyond the splenic flexure There was no anatomical evidence of complete obstruction The proximal transverse colon had, however, become adherent to the descending colon, immediately distal to the tumor, nature's attempt to overcome the impending obstruction The growth with its adjacent colon was resected, and an end-to-end anastomosis done This was difficult because of tension on the intestine Drainage was established through a counteropening in the flank Death occurred on the fifth day Autopsy disclosed an abscess in the omentum which had been placed around the suture line as a barrier

The tumor encircled the colon, embracing all its coats Within the narrowed bowel was a cauliflower mass which left a lumen of only 3 mm The microscopical section showed the tumor to be adenocarcinoma The cauliflower mass classes it with the encephaloid group

These two cases illustrate a condition which is several times described in the literature, in which the symptoms centre about the cæcum, rather than the site of the lesion

Passot (quoted by Veau) reports a case very similar to the first

CASE III—W B, male, age forty-seven, admitted to the hospital December 6, 1916 A history of recurrent diarrhœa, extending over many years—"all his life"—was obtained Constipation had never been present For two years he had suffered from indefinite symptoms described as indigestion During recent months he had noticed blood and mucus in the stools (This fact was only learned after operation) In the fall of 1916 he was under treatment for the gastric symptoms, and received gastric lavage During this procedure, late in November, he was seized with moderately severe pain at the left costal margin This had recurred intermittently since then He now refers it to a region beneath the lower ribs, from the midclavicular line backward nearly to the spine Gradually the pain has become a constant dull

ache, which is increased on any deep respiratory movement. It is also rendered more severe by a full stomach. Examination on admission showed the patient to be moderately ill. The temperature varied between  $98^{\circ}$  and  $102^{\circ}$ . The leucocyte count was 14,000, with 78 per cent polynuclear cells. There existed all the signs of a left subdiaphragmatic abscess, and the tentative diagnosis of a subacute perforation of a gastric ulcer near the cardia was made.

At operation a curved subcostal incision was carried from the mid-axillary line forward, and later enlarged by dividing the rectus muscle. On gaining entrance to the peritoneum, a large abscess was encountered containing many ounces of foul-smelling pus. Only after very considerable difficulty in separating the matted omentum from the stomach and the transverse colon in front, the spleen and the kidney behind, and the diaphragm above, was the cause of the condition discovered. A cancer of the splenic flexure, with perforation, was present. The tumor and adjoining colon were mobilized without difficulty, and the entire diseased portion, with a sufficient margin of healthy bowel on either side, brought outside of the abdomen. The Mikulicz procedure was attempted, but could not be accomplished because the proximal and distal portions could not be brought sufficiently in apposition. The required amount of bowel was therefore excised, and a tube placed in the open ends, held within a constricting purse-string (Paul's operation). The two ends were then placed in approximation and the afferent and efferent arms sutured. The greater part of the wound was closed, a gauze packing and tube drainage being placed in the bed of the diaphragm to control hemorrhage, which was rather severe.

An error was made in attempting to place the two arms of the gut in approximation. This resulted in too great tension, so that retraction occurred, and the fecal discharge from the proximal end could not be prevented from constantly reinfesting the subdiaphragmatic space. A counterdrainage was resorted to, as the result of which, an empyema developed. The original abscess cavity became clean, and a well-functionating artificial anus was established. A rib resection to control the empyema failed of its purpose, and the patient died from chronic sepsis, six weeks after the first operation.

Examination of the excised lesion showed it to be carcinoma with thick strands of cellular fibrous tissue, the scirrhus type. It involved the entire circumference of the bowel, infiltrating all the coats. A minimal lumen remained. The base of the cancer was ulcerated with overhanging edges. Its longitudinal extent was less than one inch. A perforation about one-third inch in diameter was present. A lymph-node found in the mesentery of the excised bowel showed no carcinoma.

In view of the complicating abscess and the impossibility of properly protecting it from fecal drainage, a better plan than the one followed could have been devised. A cæcostomy, with large siphon drainage, and the eventration of the involved colon, with closure of the peritoneum around it for later resection, would have given opportunity to deal with the abscess cavity. The reestablishment of the colonic tract could then have been dealt with at leisure.

An example (Schwab's case) of perforation of a similar tumor, with subdiaphragmatic abscess, is reported by Madelung Hutchinson and Walbock report a similar case (See case reports)

CASE IV—L F, female, age forty-two, admitted to the hospital April 8, 1916 For two years she had suffered from pyrosis, which was relieved by sodium bicarbonate For one month pain in the left abdomen and lumbar regions had been present It was of a dull aching character No history of any disturbance of the bowels or blood in the stools could be obtained A complete intestinal obstruction had developed five days prior to admission There was nothing found on physical examination to determine the cause of the obstruction because the marked abdominal distention obscured all else Through a median suprapubic incision it was found to lie in an annular constriction at the splenic flexure The cæcum was distended to the bursting point The median wound was closed and a cæcostomy performed, with tube drainage through an intermuscular appendix incision Recovery was satisfactory, the cæcostomy functioning well The radical removal of the tumor was done 19 days later Through a transverse incision, the tumor, which lay two or three inches below the apex of the flexure, was thoroughly mobilized in the usual way, and the bowel, from the sigmoid to above the flexure resected, Payr clamps and the cautery being used The ends were closed by chromic gut ligation, immediately behind the clamps, and the ligated ends inverted inside a double row of linen sutures, the first as a purse-string, and the second an over-and-over Lembert suture A lateral anastomosis was then done between the transverse colon and the sigmoid, the usual type of chromic and linen sutures being employed In order to obtain sufficient mobilization it was necessary to place the stoma in the transverse colon, about 5 inches proximal to the flexure, thus leaving a blind pouch of this length distal to the anastomotic opening The abdominal wound was closed to its outer portion, where the bowel ends and the anastomosis could be placed practically extraperitoneally Drains were placed so as to avoid contact with the suture lines in the intestines The cæcostomy was not disturbed, it being desired to have this as an outlet in case of any tendency to overdistention For one week the convalescence was perfectly smooth The cæcostomy functionated and there was no distention On that day there appeared a slight fecal discharge from the drainage wound, but the peritoneum did not seem infected The following day, however, the patient showed signs of sudden collapse, began to vomit persistently, without distention or other evidence of peritonitis, and died in a few hours, in spite of gastric lavage and other attempted remedies No autopsy was obtained The actual cause of death remains in doubt because there was absence of signs of peritonitis or local abscess, and in some points the symptoms suggested a pulmonary embolism For the reasons discussed in operative technic a greater length of colon should have been resected The tumor proved to be an annular growth, one inch and a half in longitudinal extent It caused a nearly complete obstruction of the lumen Microscopically the growth was of the infiltrating type, all the walls being in-

volved, and it corresponded more nearly to the scirrhus type than the colloid or the encephaloid.

CASE V—F S, male, age fifty, admitted June 27, 1916 The history showed that there had been well-marked evidence of the true condition for fully two years There existed a disturbed condition of the bowels, with diarrhoea and constipation On several occasions blood had appeared in the stools For six months he had suffered from very evident attacks of partial obstruction, followed by periods of diarrhoea These had progressively grown more severe and frequent On admission he was suffering a complete obstruction of at least three days' duration Abdominal examination showed the colon as far as the splenic flexure enormously dilated, and not apparently so beyond this The patient was a marked alcoholic and suffered from advanced myocardial and kidney lesions so that any extended operation was impossible

A cæcostomy was performed, and functionated satisfactorily. On July 20th his condition was sufficiently good to justify an attempt at an anastomosis around the obstruction, which could now be palpated as a large fixed tumor at the splenic flexure Through a median incision a lateral anastomosis, without exclusion, was done between the lower ileum and the descending colon Examination of the tumor showed it to be a large nodular neoplasm involving the entire splenic flexure, and adherent to the posterior parietes Hard, enlarged lymph-nodes were palpable in the mesentery Its excision was impracticable because of the technical difficulties, and the very poor operative risk presented by the patient

The fecal current gradually found its way through the anastomotic stoma, and the cæcostomy closed in about a month The farther course was satisfactory until on a very hot day he overworked, and indulged in excessive eating This resulted in an acute attack of vomiting and a marked retention of fecal matter in the ascending and transverse colon This was relieved by opening the cæcostomy and inserting a tube He gradually recovered and there was only moderate discharge from the artificial opening The same condition recurred, however In spite of free drainage through the cæcostomy he rapidly lost strength, and died about ten weeks after the original operation

No autopsy was obtained The diagnosis is not, therefore, microscopically confirmed, but operative palpation and inspection presented all the characteristics of carcinoma

CASE VI—Only clinical evidence exists for the diagnosis of carcinoma in this case The patient is a woman, seventy-six years of age, who was first seen on January 17, 1917, with a well-developed and practically complete attack of intestinal obstruction The pain was very severe, and was localized by the patient in the left hypochondrium A history was obtained showing that there had been two or three previous attacks of a similar nature during the preceding six months They had been progressive in severity and frequency The last one about five weeks earlier had been nearly complete It had been accompanied by the passage of blood in the stool Her physician diagnosed

cancer of the colon at that time By the use of morphine, turpentine stupes, repeated enemata, and colon irrigations the condition was again relieved at the end of one week The patient still remains in comparative health, and by the free use of mineral oil, colon irrigations and great care in diet, has been able to avoid any further attack Her age and general condition precludes urging operation, to which her family is strongly opposed The abdomen is now relaxed, and a hard, non-movable tumor is palpable in the region of the splenic flexure There can be little doubt of the diagnosis in this case A chronic inflammatory lesion, such as a diverticulitis, is a possibility, but the freedom from pain when obstruction is not present is opposed to this, as is the occurrence of obstruction without evidence of an abscess (Cf Castaigne's Case, p 38b)

These six cases illustrate in every phase the characteristics of the cases found in the literature Their further discussion may, therefore, be postponed until a review of other reports has been presented For the earlier reports we shall draw largely on Madelung's paper in 1906, which includes 93 cases from the literature and 7 of his own

Histologically, cancer of the splenic flexure differs in no way from cancer in other parts of the large intestine The growth in all cases originates in the mucosa, probably from the cells in the crypts, and it is governed by the same unknown factors which obtain elsewhere Paul's classification into the scirrhus, the colloid, and the encephaloid offers a good descriptive basis, but it must be remembered that these terms are applicable to differences in appearance rather than in essential characteristics Undoubtedly there exist determining factors which, did we but comprehend them, would help us in explaining why a malignant neoplasm arising from a constant shows such marked variation in its growth The variations are those found in cancer generally, and therefore cannot be ascribed to any influence exerted by the location in an infectious area One exception may exist to this generalization The colonic growths are prone to ulceration and perforation The bacterial action of the intestinal content may conceivably have some bearing on this complication The three varieties are not clear cut, and often the same growth shows characteristics of more than one type, as illustrated in Case I, here reported, where a hard annular scirrhus tumor showed colloid degeneration, and a central perforation, and Case III where the scirrhus and encephaloid were combined

Paul's statement that the encephaloid is the most common and the least malignant is borne out by other reporters, though unfortunately little pathological detail is given in most cases This type grows more bulkily into the lumen of the intestine, and has less infiltrating power than the other types It approaches more nearly, or differs less, from the benign polyp adenoma than the others Enlarged lymph-nodes are usually present in the mesentery, but they are often not invaded by cancer, being simply hyperplastic from infective irritation

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The colloid type stands at the head of the list, so far as malignancy is concerned, but fortunately is the least frequent. It tends to local ulceration, inside of a hard-edged circumscribed growth.

The scirrhus type, according to Paul's experience, stands midway between the other two, both in frequency and malignancy. The growth is slow and local. It is characterized by marked fibrosis. The lymph-nodes contain cancer elements. Recurrence following removal may occur at a comparatively late period.

Madelung, in his earlier analysis, arrived at the same conclusions as Paul. He, in addition, called attention to the comparative infrequency of distant metastasis. He found the liver involved only six times in 100 cases. In four instances a second growth was found in other parts of the alimentary canal, two of which, however, seemed to be independent growths, rather than metastases. In general, the reported cases confirm the comparative infrequency of distant metastases.

Huguier and Rigollot-Simonnot report a most interesting case in which cancer occurred in the left lobe of the liver. The symptoms were those of an acute abscess with high temperature and leucocyte count. Operation disclosed a cavity in the liver, a fragment of which showed carcinoma of intestinal origin. Only at autopsy was the primary growth found to be in the splenic flexure. From the description, the liver involvement was more a direct extension than a true metastasis.

Butlin (quoted by Madelung) finds that over 60 per cent of patients suffering from colonic cancer die from obstruction or other complications before a serious metastasis occurs. While no extended statistics are at hand for cancer localized to the splenic flexure, this figure is probably low rather than high for this part of the colon.

Bockel and Swain (quoted by Madelung) report the successful removal of splenic flexure cancers in which cancerous nodes were removed. They believed that involved nodes remained, and yet the patients recovered and continued well over long periods.

Madelung, after a complete survey of the evidence, concludes that lymphatic involvement from splenic flexure cancer is not as frequent as from cancer of the cæcum and ascending colon. In our study we are confronted with the same difficulty that he encountered in the study of case reports. Often it is stated that enlarged nodes were present, but no microscopical report is included. The accurate location of the nodes is rarely given. Our conclusion, based on additional cases, coincides with that of Madelung, but we can give no figures to support it. One is justified in the belief that lymphatic and distant metastases are not a serious menace to successful treatment.

From the aspect of therapy, the pathological characteristics of these growths present points both favorable and unfavorable. Their rate of growth is not rapid. Therefore, their complete removal should be possible. This is more to be hoped for because of the slight tendency to lymphatic



and distant metastasis. But since the lesion is primarily a mucosal manifestation, the early growth is not accompanied by any serious disturbance of function, and pain is not a symptom. Considering the ulcerative character of the lesion, hemorrhage from the bowel should be expected. On the contrary, this is a comparatively rare occurrence. No statistical evidence can be adduced because the records are too incomplete, but absence of mention may be taken as negative evidence. It was present in three of our cases. Madelung mentions it in ten of one hundred reported cases. Its absence is certainly of no negative value, and its presence is easily overlooked, or, unfortunately, assigned to other causes.

While the localized nature of the lesion favors its removal, the anatomical relations of the splenic flexure present difficulties not found in other portions of the colon. These difficulties are further enhanced by reason of the fact that very often, as just explained, an early diagnosis is not made because the symptoms are not marked. It is only diagnosed when some secondary condition has arisen, such as serious adhesions, obstruction, or abscess formation, any one of which adds enormously to the gravity of the problem confronting the surgeon. These factors will be more fully discussed later.

The splenic flexure is apparently the third most common site of colonic cancer (exclusive of the rectum), the sigmoid loop and the cæcum being the sites of preference. The ascending, the transverse, and the descending colon proper, are comparatively immune. It is a matter of interest to note that the hepatic flexure is not as frequently attacked as the splenic flexure.

Madelung quotes the following autopsy statistics. Bloch reports four cases of splenic flexure carcinoma among 138 cases of colonic cancer. Lambret 8 cases among 237. DeBovis 21 cases among 426. A total of 33 cases of cancer of the splenic flexure in a series of 801 cases of cancer of the colon in general, exclusive of the rectum, *i e*, 4+ per cent.

The ratio of cases reported from clinical records by surgeons is essentially different. Madelung quotes the following. Clogg 6 cancers of splenic flexure in 25 cases of colonic cancer, Dollinger 1 in 25, Hartman 1 in 10, Hochenegg 2 in 7, Korte 7 in 54, Mikulicz 12 in 86, Rotter 2 in 34. A total of 31 cancers of the splenic flexure in 241 colonic cancers—12.8 per cent.

William J Mayo, in the presentation of the Surgery of the Large Intestine before this Association in 1909, reported 61 cases of cancer of the colon, 7 of which were found in the transverse colon and its two flexures, but the exact distribution of these is not given. Cope reports finding 3 cases of splenic flexure cancer among 20 cases in the entire colon. Corner found the splenic flexure involved in 2 per cent of the cases of colonic cancer occurring in St Thomas' Hospital in 1910 and 1911. Veau mentions one case in seven. Mumford found 16 cases among 48 in the Massachusetts General Hospital records covering 16 years. Rotter reports 8 cases in a study of 49 cases of colonic cancer.

It will be noted that the various autopsy reports run fairly constant,

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the extremes being 33 per cent and 49 per cent, while the clinical reports show a wide variation from 4 per cent to a fraction less than 30 per cent. Undoubtedly the autopsy records are the more nearly correct, both because they include a greater number of cases, and because they are based on final observations and are not limited by the many factors which influence the cases coming to operation.

A search of the American, English, French and German literature since Madelung's report of 100 clinical cases in 1906, shows 57 to have been reported. Probably others are included in the general subject of colonic cancer and intestinal obstruction, but cannot be identified. Only four reports appear in the records of the New York Surgical Society (two more being mentioned but not recorded) during the last ten years, and none in those of the Philadelphia Academy of Surgery, as published in the *ANNALS OF SURGERY*. From these figures it is apparent that the condition is not a common one, and that even the surgeon of large experience can see only a comparatively small number. The rather discouraging results obtained may, to a certain extent, be due to the fact that a definite technic has not been established. The modes of attack differ markedly, and the successes do not seem to be entirely dependent upon any one procedure. Certain factors in the successes, however, stand out rather forcibly, which we shall discuss in detail later. As Veau says, the statistics are very unsatisfactory, and a conclusion can be better drawn from general impressions than from an array of figures.

From a study of the symptoms it is apparent that in many instances symptoms are present over a long period which should lead to an early diagnosis. On the other hand, diagnosis is delayed in fully one-half of the cases until a serious acute complication is added to the original lesion. In part this is the result of lack of intelligence on the part of the patient, and a less excusable lack of education on the part of the medical profession. In part, however, it arises from the fact already mentioned, that these growths may occasion surprisingly little disturbance prior to the onset of the complicating lesion. If of the scirrhus type they grow as a mildly ulcerating annular extension around the bowel. The contraction of the fibrosis tends to a narrowing of the lumen. Bleeding is not a marked manifestation, and is not sufficient to attract attention in the stool. As is well known, the intestine itself is not especially susceptible to pain-producing stimuli unless the peritoneal coat is dragged upon. This coat is involved only as a late manifestation and in many cases remains almost intact until a perforation takes place. Pain, therefore, from the presence of the growth itself, does not occur, and is only instituted when a complicating lesion arises. All these factors are also present in the colloid type, and hence its early manifestation is obscure. In the encephaloid type, the growth is less annular and more a heaped-up mass of ulcerating carcinoma. Such evidence as the very meagre reports show, seems to indicate that this type is more prone to bleed than the others, but even here the amount is rarely excessive. In the six

cases here reported hemorrhage was present in three, and while the specimen was removed in only one of these, to prove it belonged to the encephaloid group, the evidence presented by the massive character of the others so places them. The question of progressive obstruction still remains to be considered as a factor in making an early diagnosis. This should be most apparent in the scirrhus and colloid groups, because of the tendency to a contracting fibrosis. The colonic content at the splenic flexure is still rather fluid than solid, hence, a very considerable constriction may take place before the fecal current is stopped. It may be retarded, but this gives rise to no localizing symptoms. It seeps through into the lower colon, the water is there absorbed, and the recto-sigmoid reservoir produces a normal formed stool. It is thus explained that the pencil stool, so graphically described as a symptom, does not occur. In fact this is absent even in constriction much lower down, sometimes within reach of the palpating finger per anum. Experimental evidence and clinical observation both emphasize the fact that the symptoms of intestinal obstruction do not arise until the closure of the constriction stops the passage of gas. Numerous specimens show a constriction only admitting the passage of a probe, which, however, had never produced obstruction until suddenly a complete acute occlusion supervened. Case II here reported illustrates the absence of obstruction with a lumen of  $\frac{1}{8}$  inch. Case IV showed a "minimal" lumen, but never had had symptoms previous to her admission with complete intestinal obstruction. Many patients trained to careful observation under the care of competent men are totally unaware that they are seriously ill until a sudden obstruction arises. The authors studied, place the proportion of cases of cancer of the colon presenting a complete obstruction as the first really diagnostic symptom at from 40 per cent to 60 per cent. For the splenic flexure, this is probably low rather than high (*vide infra*). There is, however, one symptom which careful questioning may elicit in a minority of cases. The patient says true constipation is not present, but that even after what seems a normal evacuation of the bowel, there exists the desire for a further movement. The probable explanation of this is found in the fact that the colon above the stricture is a constantly filled reservoir, which continually feeds fecal matter into the lower bowel, so that the latter never has the normal rest to which it is entitled. It is rather surprising that colicky pains are not a more constant symptom. They are mentioned as being present in a goodly proportion of the cases, but often are not severe enough to be considered as significant. Case II illustrates this. If one examine the colon proximal to a constricting cancer, it is always hypertrophied, and sometimes dilated. This permits of its continually forcing its content through the constriction without undue peristalsis, and so long as it can avoid overdistention from gaseous content, there is no painful contraction present.

In 19 cases Madelung found a palpable tumor. In two of our cases this was true. While this does not make the diagnosis certain, it makes operation imperative when the exact condition will be disclosed.

It is thus manifest that cancer at the splenic flexure may progress to an

advanced stage without the development of any symptoms which could reasonably give rise to a suspicion of the serious lesion harbored. We may in such cases, exonerate both the patient and the medical profession from the blame attached to a delayed diagnosis. On the other hand, telltale symptoms *may* be present in a varying degree, and with careful study, ought to lead to the suspicion that cancer in or near the splenic flexure is present.

In the five operated cases here reported only one came to operative treatment prior to an acute complicating lesion which immediately threatened death. Even in this one (Case II) complete intestinal obstruction was forestalled only by a few hours. A study of the histories given, however, demonstrates that the data for a tentative diagnosis were present in three of the cases many weeks or months prior to the acute onset. The conclusion is inevitable that the importance of minor disturbances from the normal is not fully appreciated, and that the same campaign of education must be undertaken as is being done in the case of mammary cancer, uterine cancer, stomach cancer, etc. It is necessary to emphasize that the most common complication which supervenes to attract attention is intestinal obstruction of varying degree.

As previously pointed out, this is often absent until the lumen of the colon is closed to an astonishing degree. On the other hand, it may come about because of impaction, either of feces or a foreign body, because of inflammatory swelling as the result of ulceration, or because of adhesions and kinking. These various conditions are probably responsible for those cases which show repeated attacks of almost complete obstruction, followed by a comparative recovery. Cases V and VI in our report are illustrations. Many patients are seen who have suffered such attacks over many months. Then an attack more resistant to treatment than previous ones develops. The condition is then needlessly serious. A patient suffering such attacks demands the most complete study, and failing a diagnosis, exploratory operation should not be postponed beyond the second attack. This teaching is sound, but is woefully neglected. Attack after attack is tided over by various measures. The final one is treated along the old lines with the deluded hope that once successful always successful, and failure only acknowledged when death is imminent. It is not a matter of wonder that under such conditions operative results are discouraging. The question really concerns that of exploratory operation, and is not so simple as the facts cited would indicate. Between the cases presenting almost no symptoms until an acute obstruction is at hand, and those showing the marked symptoms just discussed, there is a group in which symptoms are present, but in no way urgent. They frequently occur after manifest errors in diet, or when the digestion is disturbed by overfatigue and anxiety. They are indefinite, and vary considerably in their character. They in nowise differ from disturbances which have no gross lesion as their basis. The most careful examination by every method of diagnostic aid fails to do more than arouse a suspicion of a serious condition. To advise every patient under such circumstances to submit to an exploratory operation with its

attendant risk, suffering, financial burden and other disadvantages, is a satisfactory and sure method of learning the truth, but it is a severe method if the true condition be nothing calling for or helped by operation. This picture of the exploratory operation is not overdrawn if the patient be the draftsman. The risk is known by the surgeon to be minimal, the suffering often lasts only through the nausea induced by the anæsthetic, the financial burden can be fully controlled, and the anxiety can be dispelled by a tactful optimist. The fact remains, however, that an exploratory operation with negative findings is a serious undertaking, and one in which the conscientious surgeon is loath to have part. What then is the proper course in these cases of suspicious, but no positive symptoms? It is to be found in a much more thorough study than is usually given. In private practice the patient must be taken into one's confidence, and made to carefully study his own symptoms, without being alarmed. He must, on one pretext or another, be seen at intervals, even though in apparent health. A careful analysis of the symptoms must be tabulated. Do they persist after palpable errors in hygiene have been corrected? Is there a tendency for them to become gradually more insistent? Cannot some positive evidence, such as melena, a definite pain or tenderness, or the radiographic plate be made to give the needed clue which justifies insistence on an exploration? In hospital practice we can more completely control the patient while he is actually in the ward, and as a rule can carry out all needed study. Failing, however, of any positive findings, we have more difficulty in keeping him under observation over an extended period. The development of the social service bureau, the follow-up system, and a closer affiliation between the wards and the out-patient rooms, is improving our opportunities in this direction, and except in the most unintelligent and roving classes we are able to keep in touch with our cases.

Our justification for so fully discussing this phase of the subject lies in the fact that a large proportion of our failures in dealing with cancer of the splenic flexure is directly and solely assignable to the acute or subacute complication occurring before operation is undertaken. A greater measure of primary success can only come if we devise some means to do our surgery earlier. Even with the greatest care exploration must always have a valuable place.

The problem of the surgical interference in cancer of the splenic flexure presents certain distinct difficulties which do not exist in other parts of the colon. Surgically, it is inaccessible. If surrounded by an inflammatory zone, it becomes densely adherent to the stomach, near the cardia, the diaphragm, the kidney, the spleen or the pancreas. Case reports show that all of these may coexist. The colon at the flexure, and distal to it, is provided with no mesentery. A goodly portion of its circumference, therefore, has no serous covering. The immediately adjoining segments, on both the proximal and distal sides, are not mobile, so that approximation is difficult. The failures reported may, many of them, be explained because these difficulties were not overcome. (Compare Cases II and III.) Success lies in devising a

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technic which will overcome them, and to this end a study of all the case reports collected has been made. Including Madelung's, there are 157 cases. Many of these fail to give sufficient operative detail to be of value, so that our study is based upon an analysis of 128 cases. As a conclusion of his studies, Madelung sums up:

An enterostomy (mostly a cæcostomy) was done 26 times, 24 times for complete obstruction. In only two cases was life appreciably lengthened.

Entero-enterostomy was done 12 times, 6 times in the presence of complete obstruction. One-half died immediately following operation. Of the other six, the greatest post-operative length of life reported was one year, though two were still living two and three months after the operation at the time of the report.

Enterostomy with entero-enterostomy were done 11 times, 8 times in the presence of complete obstruction. Life was prolonged in 8 of these, one living for three years and four months after operation, and one being in good health one year and three months after operation, at the time of the report. The other 6 lived for three and a half to fourteen months.

Resection was done 34 times, 14 times after enterostomy and once after enterostomy and entero-enterostomy. In the 34 cases complete obstruction existed 18 times. Twenty cases survived the operation, in 9 of whom complete obstruction was present. In six cases the length of life after operation is not given. Fourteen lived from seven months to two years or more. Six remained well for more than three years, that is a possible permanent cure was obtained in only 84 per cent. of all the cases in which operative relief was attempted.

These six were in detail as follows:

Bitlon-Pollard. Colloid carcinoma, size of fist. No lymph-nodes present. Male, age twenty-nine, flatulence for four years, colicky pain with constipation for one and a half years and melena. Resection April 8, 1901, including tumor and only two inches healthy bowel on either side. End-to-end anastomosis. In "perfect health" when reported, December 3, 1904 (three and a half years).

Hochenegg. Male, age forty-one, small annular cancer, freely mobilized and brought outside wound, surrounded with iodoform tampon. Proximal enterostomy. Resection and suture. (End to end or lateral not stated). In perfect health five years later.

Bitlon-Pollard. Female, age fifty-five years, a mass, including the cancer of the flexure, and involving the left kidney, and the tail of the pancreas was mobilized and brought out through an oblique incision. Excision of 14 inches of colon, and end-to-end anastomosis with the Murphy button. Obstruction occurred and was relieved by colotomy and removal of the button five days later. Slow convalescence. Good health five years and three months later.

Bockel. Female, age forty-three, annular cancer with lymphatic involvement. Twenty centimetres colon resected with end-to-end anastomosis. Fecal fistula for short time. Good health five years later.

Sasse. Female, age thirty-six, extensively adherent carcinoma. Resection from middle of transverse colon to beginning of sigmoid. Direct suturing end to end. Spontaneous closure of fecal fistula. In good health after seven and a half years.

Kosinski. Female, good health eight years after resection.

The following abstracts of cases since Madelung's report present points of interest bearing on the diagnosis and the outcome of operative interference

Denk I (Case 20), 1906 Male, age seventy-one, cancer of splenic flexure and gastrocolic fistula Two-stage operation Death from peritonitis and pneumonia This patient had had stomach crises for ten years For one year past emaciation, anorexia, constipation For five months putrid belching, increasing prostration For two months fecal vomiting and diarrhoea Abdomen soft, tenderness over left costal arch No tumor felt Operation Tumor at splenic angle adherent to and perforating the stomach and adherent to the diaphragm Mass shelled out and defect covered with peritoneum Resection of part of gastric wall Colon brought forward Mikulicz tamponade Next day tumor removed Adenocarcinoma Patient lived three days

II (Case 26), 1908 Male, age thirty years, cancer of splenic flexure with ileus Splashing and rumbling for eight months Belching, vomiting, obstinate constipation Occasional blood in stool For four months rigidity of bowels High degree of meteorism Distinct peristalsis No tumor felt Operation Growth size child's fist at splenic flexure Opening (colostomy) at hepatic flexure Tumor brought forward and two days later extirpated By reason of gangrene no histological examination could be made One month later von Frisch apparatus was placed in the colostomy opening and functionated well Bowels also moved naturally Two months later the enterotribe was used and in another six weeks the fecal fistula was closed with semicircular suture

III (Case 36), 1907 Male, age forty-seven years, chronic ileus For two months past had violent crises of colic and vomiting Obstinate constipation Marked emaciation Abdomen inflated No tumor felt Intestines rigid Operation Splenic flexure almost closed by cancer Brought forward with rubber drain in proximal segment In three days tumor removed Three weeks later enterotribe used In two months fistula closed with semicircular suture

Clogg Brief mention of 10 cases of cancer of the splenic flexure Two were presumably operable and were operated on radically In one case operation was successful, in the other death was due to postoperative adhesions Of 8 inoperable cases, in 1 there were secondary tumors in the liver, 1 was secondary to a growth in the ovary, 4 were hopelessly adherent, 1 ended in perforated peritonitis and 1 was associated with localized abscess Elsewhere he states that his two operations for cancer of the splenic flexure were followed by death in four months and nine months respectively

Barker Male, age sixty-two, admitted to the hospital for complete intestinal obstruction Immediate artificial anus established in the lower part of the ileum Second operation six weeks later, postponed on account of ulceration at the ileostomy wound, ileosigmoidostomy proximal to ileostomy Third operation one week later—extirpation of cancer of splenic flexure—both ends of divided colon were closed Fourth operation twelve weeks later, excision of artificial anus, and closure of the proximal portion of the ileum Distal end sutured to skin as safety-valve for the closed cæcum and colon Five years later the patient had gained several stone in weight The "safety-valve" had, until recently, discharged freely fluid with fecal taint, but is now drying up A little mucus and gas continue to escape

Hutchinson and Wolbach Female, age sixty years, had complained of abdominal pain for about six months Generalized but worse in upper half Constipated for about the same length of time The pain, slight and colicky, was almost continuous Thin, anæmic, with fairly prominent abdomen, tense and tympanic, no mass felt, no intestinal movements of ileus

On admission to the hospital the bowels had not moved for a week Prompt relief from enema In a few days return of colicky pain Exploratory incision Remains of extensive peritonitis as shown by many adhesions No sign of colonic

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obstruction (a band compressed the small intestine somewhat) Suspicion of growth within the colon Adhesions prevented an anastomosis The small intestine was freed as a first stage Against orders she ate solids and died of acute recurrence before she could be operated upon Autopsy revealed a cancerous ulcer exactly at the splenic flexure with a secondary abscess lying between the colon, kidney and spleen

Brewer Male, age forty-seven, received in the Roosevelt Hospital for acute intestinal obstruction History of numerous crises of abdominal pain for the past nine or ten months, which had always yielded to catharsis and dieting Two days before admission a crisis of pain, not relieved by catharsis Vomiting had set in with increased pain Abdomen tender and moderately distended Enemata failed No stool or gas for twenty-four hours Abdomen opened through median incision without diagnosis Small intestine and colon up to splenic flexure much distended, sigmoid collapsed Palpation revealed tumor at splenic flexure Cæcotomy done Two weeks later second operation Colostomy sealed up and long incision made over descending colon Three inches of bowel involved just below flexure Transverse colon clamped and divided two inches above mass Descending colon mobilized, isolated, clamped and divided just above junction with sigmoid Intervening gut removed, with large share of mesocolon Both open ends closed and turned in Lateral anastomosis between transverse colon and sigmoid Good operative recovery On the fifth day natural movement Colostomy wound gradually closed Discharged in good condition Diagnosis Adenocarcinoma In discussion Woolsey mentioned two cases of cancer of the splenic flexure in which there were no premonitory symptoms up to the time of obstruction In one patient obstruction was absolute Resection was performed The second patient had been in a state of obstruction for four days before visiting the hospital An artificial anus was established

Westbrook The cancer was situated a few inches below the left angle Female, age forty-seven, abdominal pain for months Six months before consultation had submitted to abdominal hysterectomy Pain continued, thought to be due to adhesions from operation An acute obstruction developed Median incision, many adhesions but no constricting bands Annular carcinoma found as above stated Five inches of bowel resected, ends brought out and sutured as double barrel Paul's tubes inserted Lateral anastomosis and closure of fecal fistula later No recurrence in four years

Syms Adenocarcinoma of splenic flexure of colon in a woman of seventy years Annular, causing almost complete obstruction Emergency operation Cancer appeared rather as a constriction than as a tumor On account of the patient's precarious condition, only a short-circuiting operation was done, the transverse to descending colon The palliative operation apparently stopped the growth of the cancer Was in perfect health four years later She then died suddenly from perforation of bowel above anastomosis, after two days of pain and constipation It was found that the disease had made no appreciable progress Diagnosis was confirmed by microscope after autopsy

Delbet Female, age thirty years, complete occlusion for five days Cæcum and ascending colon distended, sigmoid empty Delbet was unable to find the obstruction and extended the incision to the two flexures when it was located at left flexure Incision over splenic flexure immediately below the ribs, the median incision being closed

Operation in two stages Tumor exteriorized (it was but slightly movable) A U-thread was made to pass twice each through the lips of the incision and the mesentery Patient rallied notably after establishment of the artificial anus Ten days later the tumor was ablated Two months later the colon was mobilized and the two ends united with a double circular suture

Morison Male, age sixty-two years, was admitted to the hospital for acute



obstruction, following a long period of chronic obstruction Cæcostomy February 16, 1909 On March 13th removed a growth at splenic flexure with half of transverse and descending colon, with anastomosis between transverse and iliac colon March 27th, cæcostomy closed No local recurrence in four years (Later had cancer of cheek and neck lymphatics, also successfully operated upon) Colon cancer of the usual columnar cell type

Rotter's cases I (Case X) Male, age fifty-seven years Six weeks before consultation had colicky pains, worse on left side Meteorism and severe intestinal hemorrhage After a brief remission the symptoms returned Moderate degree of meteorism A large firm tumor felt below the left costal arch, extending upwards beneath the ribs There appears to have been no preoperative diagnosis other than ileus Laparotomy Cancer of the left colonic angle, adherent to posterior abdominal wall, mesentery of small intestine, and stomach Growth also penetrated into the kidney to which it adhered Attempts to loosen adhesions were abandoned Artificial anus in transverse colon Marginal necrosis of the edges of the conducting segment of bowel Operative recovery Discharged improved

II (Case XIV) Male, age fifty-nine years For several months before consultation, tendency to constipation For three days complete obstruction Marked meteorism Operation Left-sided pararectal incision Very large tumor at left angle of colon While endeavoring to mobilize this, a foetid fecal abscess was ruptured Artificial anus in left side of transverse colon Death ten days later Autopsy Diffuse peritonitis Metastases in the liver Thrombosis of left iliac vein

III (Case XVIII) Male, age fifty-four years Intestinal disturbances for two years, colicky pains at intervals for six months Intervals progressively shorter, crises more severe Abdomen moderately distended and tender to pressure After purgation abdomen softer Induced splashing sounds in small intestine First operation Cæcal fistula Palpation showed tumor in left angle of colon Second operation, one month later Mobilization and resection of portion of the pancreas, spleen and stomach Difficult detachment from kidney Radical operation abandoned Death from collapse in thirty-six hours

IV (Case XXII) Male, age thirty-nine years For months temporary attacks of colic across the abdomen Relief from purgation In past few weeks attacks frequent and severe Two days before consultation fecal vomiting, notable meteorism, no stool, no flatus When first seen was in collapse Abdomen very tender to palpation Operation Right-sided, pararectal incision Carcinoma 8 cm long in left angle of colon Transverse incision to left Tumor mobilized, extirpated Artificial anus Death from collapse in ten hours

V (Case XXIII) Female, age fifty-eight years For some months abdominal pains, not colicky Irregular stools On examination no meteorism Smooth, movable tumor to left of navel, suggesting a floating kidney Operation Left transverse incision Cancer at left angle of colon adherent to root of mesentery of small intestine, hence inoperable Ileosigmoid anastomosis Death in five days from asthenia No peritonitis

VI (Case XXXIII) Female, age thirty-eight years Uncomfortable for fourteen days Meteorism Stool only after strong laxatives On inspection marked meteorism Diagnosis of chronic ileus and cancer of left angle of colon First operation, fistula cæci A tumor size of a walnut could be felt in the flexure Second operation (interval not stated), lumbar transverse incision Tumor exactly in the angle Transverse colon thick as an arm, inflated, filled with hard stools, prolapsed Detachment from spleen and stomach The tumor and transverse colon resected together End-to-end anastomosis of right transverse to descending colon Three planes of circular sutures Sutures covered with omentum Extraperitoneal cigarette drain Complete operative recovery

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VII (Case XLV) Male, chronic ileus First operation, left-sided oblique incision Transverse colon greatly distended, prolapsed Tumor in left angle Bowel loosened A "double" anus established Second operation In crushing the septum, the result was incomplete A spur remained, and when this was split infection resulted with death from peritonitis in four days

VIII (Case XLIX) Male, age forty-three years Notes of case lost Cancer of left angle Ileosigmoidostomy Resection from middle of transverse colon to descending colon Both free ends closed and ileum divided The lower segment was sutured into wound while the upper one was united end-to-side with the sigmoid Recovery

All these patients were in bad physical condition

Renon Case I Female, age sixty years Received in hospital for intestinal occlusion of twelve days' standing She was in very bad condition The occlusion had been preceded by several months of constipation Cæcal fistula established Second stage seven weeks later Median laparotomy Recognition of cancer at the splenic angle It was extirpated and an ileosigmoid lateral anastomosis made with splenic anus One year later the lower extremity of the splenic anus was doing most of the excretion An attempt was made to exclude the cæcum, but the patient died from the operation

Case II Male, age sixty years Gastric disturbance for years, with vomiting at times and a yellowish skin For six months he had been constipated, but had had no true crises of occlusion The exploratory laparotomy revealed a small cancer at the splenic flexure The affected loop of intestine was exteriorized, and eight days later resection was performed with semicircumferential anastomosis The patient made a good recovery, and six months later the splenic anus was closed Death followed, due apparently to duodenal hemorrhage

Case III Male, age sixty-six years Intestinal occlusion Laparotomy and division of two bridges which compressed the small intestine Cancer of splenic flexure discovered Cæcal anus Two weeks later colon exteriorized and growth ablated Half circumferential suture, with resulting necrosis of a portion of the intestine Was living and well three years later, and would not consent that the splenic anus be closed

Case IV Male, age fifty-nine years, sudden intestinal occlusion Cæcal anus Nearly six weeks later exploratory laparotomy Recognition of cancer of the splenic angle Immediate extirpation Death from peritonitis

Truesdale (two cases) I Female, age sixty-three Acute obstruction present Laparotomy with mobilization of the tumor and adjoining colon Transverse colostomy Twenty days later resection with lateral anastomosis, the closed ends being placed extraperitoneally in the abdominal wound as advocated by Bloodgood Recovery Seen thirteen months later with evident uterine cancer

II Male, age sixty There was no obstruction, but rapid loss of weight, and a growth palpable through the soft, flat abdomen To distinguish between a growth on the greater curvature of the stomach and one at the sigmoid flexure, X-ray pictures were taken The greater curvature was seen to be smooth, pylorus normal The transverse colon showed interference with peristalsis The bismuth appeared to collect in an irregular mass toward the splenic flexure, beyond which was a short segment in which the bismuth showed canalization On this evidence a diagnosis was made of cancer of the splenic flexure After several days of preparation, a laparotomy was done Resection of the tumor and a safe margin of the healthy colon Anastomosis impracticable because of tension Lateral ileosigmoidostomy done with double exclusion Cæcostomy to drain the remaining closed colon Recovery In good health thirteen months later

Abbott Two cases I An adenocarcinoma of the splenic flexure in a woman of forty Eleven months before admission began to be troubled by constipation This increased until four months later she exhibited absolute obstruction with

vomiting Spontaneous recovery Two months later a second attack of stoppage when a cæcal fistula was instituted Recovered again with persistence of a slight sinus which occasionally leaked Constipation again returned, and there was, on one occasion, a four-day attack of vomiting Was now losing flesh When first seen, abdomen was distended, and nothing could be palpated Laparotomy Growth at splenic flexure of colon Right lumbar colotomy Second stage deferred because of suppuration in anterior wound After some weeks an extensive resection was performed, followed by lateral anastomosis Good operative recovery

II Male, age sixty-five years When first seen he was in the hospital with abdominal distention, obstipation and vomiting He had had a similar attack one year before Relieved by use of laxatives He had a second attack four months later, and was in the hospital five weeks Since then he had had almost daily trouble The distention suggested obstruction at the splenic flexure An exploratory incision to the left of the median line failed because of distention Wound closed and right lumbar colotomy performed Eighteen days later second stage Inflammatory adhesions held the mass up The same operation as in preceding case Drainage through a stab wound in the loin in both cases

Souligoux Male, age sixty years Seized with vomiting As he had suffered a long time with stomach trouble, a diagnosis was made of stenosis of the pylorus Concluded in by a number of colleagues Laparotomy Cæcum, ascending and transverse colon very voluminous, distended with gas Stomach was entirely normal At left angle of the colon a neoplasm, fixed and hard This was exteriorized with difficulty and a cæcal anus established Patient died in the night

Aaron Male, age fifty-five years Sick for past year with "stomach trouble" and had lost thirty-five pounds Constipated and cachectic About five months before exploratory laparotomy had disclosed a presumably inoperable cancer of the splenic flexure For six months he was treated with vaccines Was then operated on (extensive resection and anastomosis between hepatic flexure and sigmoid) and he died eight days later from hypostatic pneumonia The growth was an adenocancer of the flexure in an advanced stage

Wette Briefly mentions one case which exploration showed to be large and inoperable

Savariand Case reported by Bary Female, age not given Ileus of two days' duration, violent pain and complete occlusion There was a history of two similar crises, two months and one month before, less prolonged and less severe There was a tender point in the epigastrium a little to the left of the midline There is no allusion to any preliminary diagnosis Median laparotomy disclosed a dilated transverse colon, a loop of which was exteriorized Twelve days later the cancer was excluded by an ileosigmoidostomy The anastomosis functionated at first, but a fecal abscess formed and the fæces escaped through the fistula In eighteen days the cancer at the flexure was extirpated by resection, and end-to-end anastomosis, and the abdomen closed Healing was marred by abscess formation, but ultimately there was complete recovery, the fistula healing spontaneously

Mumford Cites an inoperable cancer of the splenic flexure the first indication of which was an acute obstruction

Veau Prolonged history of partial obstruction with severe attacks No blood in stool Cæcostomy done in presence of acute obstruction Position of tumor afterward determined by bismuth X-ray examination Six weeks later the tumor, with adjoining bowel, was mobilized and brought out of the abdomen, without sectioning the mesocolon, the afferent and efferent arm being placed in apposition The parietal peritoneum was closed around the colic peritoneum One week later the tumor was removed with the cautery, the afferent and efferent loops sutured in contact About three weeks later the enterotribe was successfully used and after two weeks the open ends of the colon were closed under local

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anæsthesia Finally the cæcostomy was closed Patient in excellent health with normal bowel function at the end of two years The cancer was scirrhus in type, annular in growth, and there remained a lumen of 8 mm

He reports two cases I Passot Male, age fifty-six years Cancer at splenic flexure with obstruction and peritonitis due to perforation of cæcum Laparotomy with establishment of cæcal fistula at the perforation and peritoneal drainage failed to save the patient Autopsy revealed a large cancer at the flexure which was adherent to the pancreas, kidney, and stomach

II Patel et Murad Male, age fifty-one years Entered with symptoms of obstruction Operation revealed a peritonitis, but no mechanical obstruction Cause of peritonitis not determined Death Autopsy revealed a cancer at the splenic flexure Small, annular, stenosing Colon dilated No perforation "Peritonite par propagation"

Peck Male, age forty-seven years September 12, 1909 Obstinate constipation for three months Partial obstipation for two weeks No blood in stools Mass felt on deep palpation just below the left costal arch Operation September 13, 1909 Cancer of the splenic flexure Somewhat fixed to posterior parietes Numerous enlarged glands in mesocolon were found Distention of transverse colon Growth, with adjoining transverse, all of the descending and part of the sigmoid, together with accompanying lymph-glands, was mobilized and excised Nineteen inches of bowel removed Cut ends inverted, side-to-side anastomosis between transverse colon and sigmoid Cigarette drain Most of abdominal wound closed Patient in marked operative shock from which prompt recovery was made Normal defecation on third day Slight fecal leakage on sixth day, with spontaneous closure on fifteenth day Patient was exhibited fourteen months in excellent condition Weight was ten pounds above normal Growth described as advanced carcinoma, with a good deal of associated inflammation Histology of lymph-nodes not given

Moynihan Female, age sixty-two years Diagnosis of malignant stricture of the splenic flexure, crises of subacute obstruction of bowel After enemata the abdomen became hollow, and the growth could be felt plainly Laparotomy showed a distended transverse colon, and a collapsed descending colon and sigmoid Tumor is so adherent in all directions as to be inoperable An ileosigmoidostomy was then performed The patient at once improved and after an interval—not stated—the tumor was no longer palpable Moynihan states that it is "almost" certain that it could not have been cancerous, but "some form of chronic inflammation" The question is thus left open

Paul states that he is convinced that such cases may be cancer (Cf Syms case)

Huguier Female, age fifty-nine years Gave a history of crises of diarrhœa and pain Former went back for three years, while the latter were very recent A large tumor was readily made out by palpation Nutrition was excellent A renal tumor having been excluded by ureteral catheterization, a laparotomy was performed The belly of the tumor was constituted by the splenic flexure It was a fatty looking mass which adhered to the abdominal wall, and after mobilization the colon was resected and an end-to-end suture applied The growth was as large as two adult fists, and was surrounded by a layer of adipose tissue "pericolite grasseuse" The mucosa of the colon was the seat of an annular mass of cauliflower appearance with ulceration The tumor is called a cylindrical epithelioma

Castaigne Female, age forty-two For two years she had had some affection which could not be diagnosticated There was pain about the stomach and spleen, severe, occurring in irregular crises Were found to occur very often, two or three hours after a meal She also had these pains at times when at stool, and then they appeared to come from the stomach, which felt heavy There was

some radiation to the left shoulder, and at times she vomited. The syndrome was like biliary colic, only on the wrong side. She had had more or less stomach disorder since childhood. Her physicians, therefore, regarded her as a nervous gastropath. She consulted an expert neurologist, who confirmed this diagnosis. She was placed under a gastrologist's care, who found marked hyperchlorhydria. Examination of fecal matter showed absence of blood and other abnormal constituents. For three months she improved on regimen. The painful crises then returned. She was radiographed, and a diagnosis made of cancer of the splenic flexure of the colon. The stomach was now found free from all acid whatever. Refusing to entertain the diagnosis of malignancy, the patient began to travel for her health, visiting cures and sanatoria. The diagnosis was an isolated gastropathy. She improved somewhat, and was told that the radiograph taken had no diagnostic value. She returned to Paris seven or eight pounds lighter, went to Jura and regained her weight. The author was now consulted and ignored all former diagnoses (he was not told of the X-ray). He found that she was using some morphine, and her physiognomy suggested carcinoma. Palpation revealed an abdominal tumor of uncertain localization. A splenic tumor could be eliminated. An X-ray was advised. Two different men examined her, and both agreed on the diagnosis, "neoplasm of the splenic flexure." Just as she was about to be operated on she developed an intestinal hemorrhage and signs of peritonitis, and died four days later.

Among the foregoing there are records of 43 cases since Madelung's paper in which the result of operation is stated. There were 21 primary recoveries, and 22 operative deaths, a mortality of 51.1 per cent. In 14 instances the operation was palliative, while in 29 cases a radical removal of the growth was done. Of the latter, 17 survived the operation, while 12 died following it, an operative mortality of 41.3 per cent. The radical operation of resection was done 19 times, either as a second stage operation after enterostomy, or with a coincident enterostomy at the time of the resection, and 10 times without provision for colonic drainage. Fourteen of the first group survived and 5 died, an operative mortality of 26.3 per cent. In contrast to this, only 3 of the patients in the second group survived and 7 died, an operative mortality of 70 per cent, nearly three times as great as in the first group. This marked difference must be due in some degree to the fact that colonic drainage is a measure of safety and not entirely to coincident factors.

The records contain many reports of only one or two cases, and as a rule these are only published when successful. Again we find reports in more than 30 cases in which there is every reason to believe that recovery did not take place, though the text is silent on this point, the presentation being from the pathological standpoint, or for the purpose of illustrating some point in symptomatology.

Making due allowance for all these sources of error, we are inclined to believe the operative mortality in cancer of the splenic flexure is 60 per cent or more, if all cases are included in which any attempt to operate is made. The records are woefully inadequate for determining the proportion of the 40 per cent that continue in good health for a year or more. Madelung found only 6 cases in 83 that could be considered as cured. (Three to

eight years ) Rotter seems to have only 1 in 10 Veau and a possible 1 in 3 Only 1 of our 5 operated cases lived more than three months, and he died in something over two years from peritoneal carcinosis

It would be a matter of interest to determine the mortality and the probability of cure in cases that were operated prior to the appearance of acute symptoms, but we have been unable to satisfactorily do this There are scattered records of at least 28 cases, in which operation was successfully undertaken in the presence of either obstruction or abscess formation, and curiously enough some of the most satisfactory and permanent results were obtained in spite of apparently hopeless conditions, *e g*, Bilton-Pollard, Sasse, Brewer, Truesdale, and temporary smears in Cases I and III of our series

It is thus evident that cancer of the splenic flexure, the failures notwithstanding, is a lesion with which surgery may successfully deal Our problem, therefore, is to utilize the means at our disposal and make them more effective The all-important question of early diagnosis has been fully discussed How urgently this study is needed is emphasized by the fact that in more than two-thirds of the cases just cited, all the evidence for a diagnosis was present many months before the patient came to operation with an acute life-endangering complication

There remains for consideration the actual surgical procedure to be followed, first in the uncomplicated cases, and second in the complicated cases Two principles obtain in the practice of various operators, and our study of the literature leads to the conclusion that successful results reward one much more than the other

These principles may be designated as the one and the two or more stage attack In the first an attempt is made to eradicate the disease and completely restore the patency of the colonic lumen at one sitting This is accomplished either by a closure of the severed ends of the colon and a lateral anastomosis or by end-to-end anastomosis

The many stage operation is variously accomplished A preliminary cæcostomy or colostomy is done At a subsequent date the tumor and adjoining bowel is mobilized and brought outside of the peritoneal cavity with the afferent and efferent loops in contact, and excluded with tampons or peritoneal suture At a third sitting the requisite amount of bowel is excised, the afferent and efferent stomata remaining open As a next step the enterotribe is used to reestablish the colonic lumen and finally, if need be, the cæcostomy and the colonic openings are closed This, in general, is the Mikulicz operation Paul modifies it by removing the segment of colon and placing large glass tubes securely in the open ends of the colon at the second sitting It is further shortened by various reporting surgeons by dispensing with the primary artificial anus Others do the lateral anastomosis also at the sitting, so as to eliminate the later use of the enterotribe

Most writers agree that the many stage operation or its modification, is safer than the other, and strongly advocate it in spite of its long incapacitating and unpleasant course (*e g* Mikulicz, Madelung, Rotter, Paul, Veau-

deau ) Our collected cases show a mortality approximately 3 times greater in the one stage than in the many stage procedure Careful study indicates that the failures in the one stage operation would have been avoided by the other mode of attack These failures arose almost entirely from leakage somewhere along a suture line, with a resultant peritonitis or improperly drained abscess (Case II in our series )

In the final analysis it must be accepted that greater safety is maintained by the abandonment of the one stage operation There is a definite field for it in cancer of the more mobile parts of the colon, but not in the fixed inaccessible splenic flexure

Naturally, its abandonment is imperative in the complicated cases In the presence of obstruction or abscess formation, it is foolhardy to attempt a radical operation It is absolutely needful that a preliminary drainage of the colon be established, and a sufficient time be allowed for recovery of the inflamed proximal bowel before any resection is attempted

One additional point of importance remains to be discussed, *i e* the extent of bowel to be removed with the contained tumor As pointed out, the flexure itself, with its immediately adjoining colon, particularly on the distal side, presents a considerable surface devoid of peritoneum The absence of a circumscribing longitudinal muscular coat in the colon leaves a very thin wall where both peritoneum and muscle are lacking Suturing such portions is a matter of difficulty and uncertainty Moreover the mobilization of the distal transverse colon and the proximal descending colon is sometimes not sufficient to bring the two into close alignment (See Case III ) Tension results, and renders the suture line still more precarious All these difficulties are surmounted if one frankly sacrifices the distal half of the transverse, and the entire descending colon The remaining transverse colon and the sigmoid are readily mobilized to a sufficient degree to lie in close parallel contact, and both are covered with peritoneum, practically throughout These facts make their immediate lateral anastomosis easy, or give ideal conditions for the subsequent use of the enterotribe

The following conclusions sum up the results of the study of our own cases and of the additional ones we have been able to find in the literature

- 1 The splenic flexure is the third most common site for the growth of colonic cancer

- 2 This growth tends to the production of obstruction with indeterminate premonitory symptoms

- 3 This complication occurs acutely in nearly three-fourths of the cases coming to operation

- 4 A recognition of the foregoing facts, and a more careful detailed study, with a possible exploratory operation, should lead to an early diagnosis in a majority of the cases, and thus forestall acute complications

- 5 The probable operative mortality of all cases up to the present time is over 60 per cent , and the per cent of the prolonged cures is exceedingly low, 10 per cent. to 25 per cent

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6 These appalling results are largely due to the delayed diagnosis, and an improper mode of attack

7 The latter should follow the principle of the two or more stage operation with provision for external colonic drainage, either as a preliminary, or at the time of resection, always the former in the presence of serious obstruction or abscess formation

8 The distal portion of the transverse colon, the flexure and the entire descending colon must be resected in order to obtain the requisite conditions for a secure anastomosis with an ultimate patency of the colonic lumen

9 Notwithstanding the meagre success thus far obtained, attention to the lessons learned from the successes and failures of those who have worked in this field justifies the hope that this lesion may be as satisfactorily dealt with as cancer in other parts of the body

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## INFECTIONS IN PROSTATE CASES<sup>1</sup>

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THE importance of the pre-operative treatment and the postoperative care of patients following prostatic operations is well established. A great deal has been done also to improve and simplify the operative technic, so that at the present time the operation is a much more definite surgical procedure than formerly. The element of infection in these cases has received due consideration, although apparently a great deal remains to be learned. In two seemingly parallel cases, one patient may have a very severe infection at any time following the operation. It is an accepted fact that the patient who has cystitis and other evidence of chronic infection at the time of operation is likely to be a better risk and is almost certain to have an easier convalescence than the patient who has a perfectly clean bladder and no symptoms of infection in the urinary tract. This would seem to suggest that the infection had produced a definite immunity, and further that some benefit might be expected from the preliminary use of vaccines.

In the majority of instances a very definite and characteristic reaction is brought about by pre-operative treatment. Just what the etiologic factor of this reaction is has not been decided. It is characterized by general weakness, irritability, inability to rest, and loss of body weight. During the height of the reaction the specific gravity of the urine and other tests show that the function of the kidney is very much diminished. There is a marked reduction in the blood-pressure, which is usually high. After the reaction subsides all these symptoms disappear. The renal function apparently returns to normal, although the specific gravity of the urine will probably never reach the point of its first reading. During the reaction there may be much evidence of infection such as chills, increased temperature, and pus in the urine, and in some instances blood cultures will be positive. This infection, if it is an infection, is characteristic. A patient well along in years will withstand a long abdominal operation under a general anæsthetic even though there is considerable infection in the operative field, and yet if at any time during convalescence this same patient has retention of urine so that catheterization is necessary for some time, there is almost sure to be more reaction from this procedure than from the abdominal operation. I do not believe we can accept the theory that the reaction which generally follows catheterization and the withdrawal of the residual urine is always due to infection alone. The reaction may occur at any time without any evidence of infection, and it would seem that it might be due

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\* Read before the American Surgical Association, June 1, 1917

## INFECTIONS IN PROSTATE CASES

to the change of pressure within the pelvis of the kidney, which permits a sudden congestion. This in turn interferes with the renal function.

In the somewhat detailed study of a small series of cases herewith presented an attempt has been made to ascertain as nearly as possible the part infection plays in the reactions which take place during the preparation of patients either by draining the bladder through a urethral catheter or through a suprapubic opening. It has been of interest also to find out just how often infection occurs during convalescence, and how much of a factor it is in the convalescence and in determining the mortality.

Infection in the kidney is the most important factor to be taken into consideration. The question arises as to whether many of these patients do not have a more or less chronic infection of the kidney from the beginning of the urinary symptoms. An infected kidney does not continuously pass organisms into the urine. An area of infection may be walled off so that the urine is free from pus and organisms except at intervals when the area opens up and discharges into the calyx or pelvis. This is known to have occurred in several instances, the urinalysis did not indicate any infection in the kidney, although at operation or autopsy considerable evidence of infection was shown. I believe that this is a frequent condition in prostate cases. As soon as any treatment is begun, the infection increases because of the changes brought about in the kidney, and bacteria and pus appear in the urine. The change in the urinary apparatus is made by the withdrawal of the residual urine. When the urine is free from bacteria before treatment is begun, but shows pus and organisms a short time afterward, it is usually believed that the infection is due to contamination during treatment. This is undoubtedly true in some cases, but it would seem that the appearance of pus and organisms in the urine does not necessarily mean the treatment has caused an infection. Just why the kidneys become infected, and the route by which the infection enters them, has been the subject of considerable discussion. Crabtree and Cabot<sup>1</sup> believe that the blood stream is by far the most frequent source of infection. They cite the case of a man under preparation for prostatectomy whose urine at the time of admittance to the hospital was found by culture to be free from infection. The catheter had been in place for several days during which time there were no symptoms and the cultures were sterile. On the eighth day the patient complained of burning in the urethra, two hours later he had a chill and a sharp rise in temperature. Blood cultures made two and a half hours after the onset of symptoms showed a pure growth of colon bacilli. No bacteria were found in the cultures from urine made at the same time, but cultures of the urine several hours later showed abundant colon bacilli. The functional test dropped twenty

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<sup>1</sup>Crabtree, E. G., and Cabot, H. Colon Bacillus Pyelonephritis. Jour. Am. Med. Assn., 1917, lxxviii, 589-591.

points in twenty-four hours. The patient presented all the evidence of pyelonephritis, but with constant urethral drainage for another week renal function returned to within five points of the former reading. At this time a prostatectomy was performed. A secondary hemorrhage occurred on the ninth day and the patient died. The autopsy showed that the kidneys were pale and had normal markings. There was no dilatation of the pelves. Crabtree and Cabot believe this case to have been one of pyelitis and pyelonephritis. The diagnosis of pyelonephritis was based on the sudden drop in the kidney function, which they think was due to cloudy swelling probably involving the tubular portion of the kidney. They believe that in such cases the perivesical tissue becomes infected, but instead of lymphatic extension to the kidney, which is against all rules, the infection enters by way of the blood stream.

In some of these cases infection ascending by way of the urinary passages is probably the source of the kidney infection. Ordinarily, infection does not occur in this manner, but when there is an inflammatory thickening in the wall of the bladder and also in the lower end of the ureter (especially if there is obstruction in the urethra, producing back pressure into the ureter), infection may readily extend to the kidney through the lumen of the ureter.

Infection might ascend by way of the lymphatics if all the lymphatics were blocked, but under ordinary conditions, with the lymph draining normally, infection at the lower end of the ureter would be passed to the lymphatic glands in front of the sacrum. It is more likely that the perivesical infection finally reaches the kidney by extending into the lymphatics and then entering the blood stream.

The effect of the infection on the function of the kidney depends on the part of the kidney involved. There may be chills, fever, and considerable pus in the urine, and yet the renal function may not be greatly reduced. On the other hand, with little evidence of infection—no rise in temperature, no organisms in the urine—the renal function may be very greatly reduced. If the infection attacks the cortical part of the kidney, as is usually the case when it is of coccus origin, there will be considerable evidence of it, but the renal function may appear normal. If the infection enters the region of the tubules, even though it causes only a swelling in this region, the phthalein output is usually greatly diminished. This type of infection is usually produced by the colon bacillus. If the infection is mixed and due to colon bacilli and cocci as well, there will be much pus in the urine, marked evidence of infection, and also greatly reduced function.

Infection in the ureter is generally secondary to an infection in the wall of the bladder. The ureter is dilated, the coats are greatly thickened, and there are no peristaltic contractions. The dilatation of the ureter must be due to the increased pressure, and the hypertrophy to the

effort to force the urine past the obstruction. The trauma which precedes infection in the bladder and ureter is produced by the over-distention. Cystitis is often due to trauma produced by the catheter.

In the study of these cases bacteriologic examinations have been made of the urine and blood and also of the prostate and the wound after operation. In nearly all such examinations the blood cultures were negative, possibly because of the fact that they were not made immediately following the chill. According to Bumpus, cultures will often not be obtained from the blood a few hours after the chill.

The bacteriologic examination of the urine in five consecutive cases in which complete data were obtained showed that before treatment of any kind had been instituted *Staphylococcus albus* could be demonstrated in the culture in four of them. In one the showing was very scanty. In the fifth case no growth had developed in the media at the end of the fourth day. While all these cultures were taken with great care, it is not possible to be absolutely certain they were free from contamination. The presence of the cocci in the urine could not be explained. None of the patients had any rise in temperature or showed other evidence of infection.

A second bacteriologic examination of the urine was made of three of the five patients four days after the preliminary treatment was begun. The other two did not require pre-operative treatment. It is especially interesting to note that in all the cases, in addition to the staphylococci that were present at the first examination, there were colon bacilli in some or all of the media. In Cases III and IV, in which a primary prostatectomy had been performed, the urine gave a positive culture of colon bacilli in one case on the fourth day after the operation, and in the other on the fifth day, so that all five patients had colon bacillus infection four or five days after the beginning of treatment. The patient who had a primary prostatectomy showed some evidence of infection. On the fourth day he developed a temperature of  $101.5^{\circ}$ . In two instances cultures were taken of the hypertrophied prostate as soon as it was removed. The culture from the patient who had not had any preliminary treatment was negative. The culture from the patient who had been catheterized for several weeks showed a positive growth of colon bacilli.

The five patients all made good recoveries without complications. They were discharged with wounds completely healed within five weeks after the prostatectomy. Only one patient had a temperature as high as  $102^{\circ}$ , and this lasted but a few hours. Possibly the convalescence in these cases was better than is usual, yet at approximately the same time after the beginning of treatment, cultures of the urine in each case showed colon bacilli and staphylococci. This would seem to suggest either that these patients had a natural or acquired resistance to these bacteria, or that the bacteria were not especially active. There was no suggestion at any time of insufficient elimination from the kidney. Since

positive cultures were found in all these cases, does it not seem probable that they are common in this condition? Such cultures point out what will take place if for any reason the patient's resistance is greatly lowered or the activity of the organisms is increased

Vaccines were not given in these five cases. Recently we have made a study of twenty-one prostatic cases to determine the effect of the use of *Bacillus coli* vaccines. Twelve of the cases were pre-operative and nine postoperative. Each patient received *Bacillus coli* vaccine every four days, beginning with fifty million and increasing to five hundred million, the maximum dose. A microscopic examination of the urine was made every week, and, with one exception, colon bacilli were found. However, none of the twenty-one patients has shown any evidence of severe infection, and it is possible the use of the vaccine may have modified the infection considerably in spite of the fact that the colon bacilli persisted in the urine. Two of the twenty-one patients had chills. A blood culture made from one at the beginning of the chill was sterile. Both had white blood counts during the chill showing only about 25,000 leucocytes. The phthalein output dropped 10 to 15 per cent at the time of the chill.

#### CONCLUSIONS

1 In prostatic cases, a definite reaction occurs during the pre-operative treatment. In some cases this reaction may be due to infection in the kidney.

2 Several days after the beginning of treatment or after the operation has been performed, in a very large majority of cases, the urine shows a considerable number of colon bacilli. This cannot be due to contamination in every instance, although we are unable to say whether it comes from the kidney, the bladder, or the prostate itself.

3 The infection may be walled off in the kidney and therefore no organisms will show in the urine. Simultaneously with any form of treatment, the infection becomes active and the urine immediately shows bacteria.

4 Colon bacillus vaccine may modify the infection, though it does not decrease the number of colon bacilli in the urine.

#### CASE REPORTS

CASE I (A186131)—S. H., a farmer, fifty-seven years of age, married thirty years, twelve children. Urgency of urination, smarting and burning had existed for eight years and dribbling for three years. There had never been complete retention and a catheter had never been used. The patient had lost 15 pounds in weight. There was bilateral enlargement (encapsulated) of the prostate, 3 on a scale of 4. The bladder was distended. The right eye showed secondary optic atrophy, the left eye was negative. A twelve-hour specimen of the urine, 600 c c, had a specific gravity of 1026, an acid reaction, and an

## INFECTIONS IN PROSTATE CASES

occasional pus cell, but was otherwise negative. Combined phthalein test 260 c c, 60 per cent in three hours. There were 8 ounces of residual urine. The blood Wassermann test was negative. Blood urea (Van Slyke) 29 mgs of urea per 100 c c. The preparation of the patient consisted of catheterization twice a day for a few days and the use of a permanent catheter for several weeks. There was considerable general decline when the catheter was first used, but the subsequent improvement was marked. The blood-pressure before treatment was 125, 83. The phthalein return varied from 35 to 70 per cent in two hours. On the eighth and eighteenth days during the preparation a chill, followed by a rise in temperature, occurred. A suprapubic prostatectomy was performed, the capsule being sutured and the bladder completely closed. A urethral catheter was inserted for drainage. The temperature did not run above 100, there were no complications, and the patient was dismissed with his wound entirely healed on the eighteenth day.

Examination of the blood before any preparation was made showed 70.7 per cent polynuclears and 5400 leucocytes. At the time of the prostatectomy there were 74 per cent polynuclears and 13,200 leucocytes. Several days after the prostatectomy there were 86.7 per cent polynuclears and 25,600 leucocytes.

Bacteriologic examination of the urine before any treatment revealed *Staphylococcus albus* and a large saprophytic coccus on all media. The anaerobic culture was not good. Bacteriologic examination of the urine after four days of repeated catheterization showed *Bacillus coli*, *staphylococcus*, and yeast cells on a blood-agar culture. *Bacillus coli* and a *staphylococcus* were present on glucose agar. Bouillon gave a growth of *Bacillus coli*. Anaerobic cultures showed *Bacillus coli* and *staphylococcus*. Cultures of the urine some time after operation showed the pneumococcus on all media.

Bacteriologic examination of a glucose-agar culture of material taken from the gland at the time of prostatectomy showed the pneumococcus and *Bacillus coli*. Blood-agar, bouillon, and anaerobic culture gave growths of *Bacillus coli* and a gram-positive diplococcus, probably a pneumococcus.

CASE II (A184364) —G. H. L., a farmer, sixty-one years of age. This patient was an old alcoholic and had had frequency of urination for five years. One week previous to our examination he had acute retention. The catheter was used once and since then there had been incontinence. Weight normal. Heart action slightly irregular. Hemorrhoids. Rectal examination revealed a large benign prostate. The blood-pressure after treatment was 150, 88. Urinalysis. 400 c c, specific gravity 1018, albumin, red blood-cells and white blood-cells. Blood urea 21 mgs in 100 c c. Phthalein test 45 to 50 per cent returned in 7 to 17 minutes. Because of the acute retention and much pain on passing the catheter, the preparation consisted in preliminary drainage of the bladder by suprapubic cystostomy. During the two weeks following this operation there was continuous improvement and at the end of that time a prostatectomy was performed. The tem-

perature rose to  $102^{\circ}+$  soon after the operation, but was returned to normal in three days, and remained so until the patient was discharged with his wound healed at the end of four weeks

The blood examination made when the patient was first seen and before any treatment had been given showed 70.7 per cent polynuclears, 15,600 leucocytes. Six days after the drainage operation there were 67.7 per cent polynuclears, 8200 leucocytes, six days after the prostate was removed, 77.3 per cent polynuclears, 18,400 leucocytes.

Bacteriologic examination of the urine before treatment revealed *Staphylococcus albus* in bouillon, glucose-agar, and blood-agar cultures. Anaerobic glucose-agar culture was sterile for four days. Bacteriologic examination of the urine after suprapubic drainage revealed the staphylococcus, pneumococcus, and *Bacillus coli* in a bouillon culture. Blood agar showed the pneumococcus and *Bacillus coli*. Anaerobic agar showed the *Bacillus coli* and pneumococcus. Bacteriologic examination of the urine eight hours after prostatectomy showed the *Bacillus coli* and streptococcus in glucose-agar culture. Blood agar gave a growth of *Bacillus coli* and a diplococcus. Anaerobic culture showed the *Bacillus coli*. Blood agar and bouillon cultures of the urine six days after prostatectomy showed the *Bacillus coli* and a streptococcus. Glucose agar gave a growth of *Bacillus coli* and pneumococcus.

Bacteriologic examination of a culture taken from the wound four days after suprapubic drainage showed a staphylococcus in bouillon. The anaerobic culture was sterile. Glucose agar and blood agar showed the *Staphylococcus albus* and *Bacillus coli*. A culture made from the wound at the time of the prostatectomy showed *Bacillus coli* and staphylococcus. Six days after the prostatectomy, cultures from the wound showed the staphylococcus and *Bacillus coli* on glucose agar and in anaerobic media.

CASE III (A4162)—M. D. S., a banker, fifty-six years of age, married twenty-eight years, two children. This patient had had urinary difficulty for six years, gradually growing worse. For three years he had had dribbling. He had never used a catheter. The physical examination was negative except that a hard and encapsulated enlargement of the prostate was palpated per rectum. The blood-pressure was 154/98. Urinalysis 400 c.c. in twenty-four hours, specific gravity 1021, slight amount of albumin and pus. The blood examination showed 83 per cent hæmoglobin, 9400 leucocytes. There was 1 ounce of residual urine. Phthalein test 50 per cent returned in two hours. Blood urea 33 mgs. to 100 c.c. It did not seem necessary to institute any preliminary preparation. A prostatectomy was done without the drainage operation, as the amount of residual urine was small and the other examinations were satisfactory.

Examination of the blood on the day of the operation showed 66.7 per cent polynuclears, 8800 leucocytes. Four days after operation there were 84 per cent polynuclears and 11,600 leucocytes.

Bacteriologic examination of the urine before operation showed a scanty growth of staphylococci on all media. The blood-agar culture of the urine five days later (the patient's temperature had been  $101.5^{\circ}$

the evening before, the highest at any time during the convalescence) showed *Bacillus coli*, staphylococcus, and pneumococcus. A bouillon culture gave a growth of pneumococcus and staphylococcus. Glucose agar showed *Bacillus coli* and staphylococcus. The anaerobic culture showed *Bacillus coli* and pneumococcus.

A culture made from the prostate soon after it was removed showed no growth.

The convalescence was uneventful and no evidence of infection was noted at any time. The wound was slow in healing, but this was evidently due to the condition in the prostatic urethra and not to the infection.

CASE IV (A187926) —J. L. G., a janitor, sixty-five years of age, married thirty-four years, three children. The urinary difficulty had begun three years previously with urgency of urination and dribbling. The patient had never been catheterized. The physical examination was negative except that on palpation per rectum the prostate seemed to be benign, but enlarged, firm, and hard. The blood-pressure was 150-115, 150-90. Urinalysis 600 c c in twelve hours, specific gravity 1030, otherwise negative. The phthalein returned in fifteen minutes, 60 per cent in two hours. There were 2½ ounces of residual urine. Blood urea 37 mgs in 100 c c. Examination of the blood showed 54 per cent polynuclears, 4800 leucocytes. As the patient's general condition was good, the amount of residual urine small, and the specific gravity and renal function normal, it was not considered necessary to institute preliminary treatment, and suprapubic prostatectomy was performed.

Examination of the blood on the day of the operation showed 86 per cent polynuclears, 10,600 leucocytes. Four days after the operation there were 80 per cent polynuclears and 10,500 leucocytes.

Bacteriologic examination of the urine before any catheterization and before the operation showed staphylococci in all cultures. Anaerobic and aerobic cultures in bouillon and glucose agar were sterile. Blood agar showed no hæmolyzing streptococci. Four days after the operation a glucose-agar culture of the urine showed *Bacillus coli* and pneumococcus. Blood agar also gave a growth of *Bacillus coli* and pneumococcus. Anaerobic and aerobic cultures in bouillon showed *Bacillus coli* and pneumococcus.

Four days after the operation a culture from the wound showed *Staphylococcus albus*.

There was no rise in temperature or suggestion of infection at any time during the convalescence (the temperature was never more than a fraction above 99°), but on the sixth day a considerable number of colon bacilli and cocci were found in the urine. The wound healed in a little more than three weeks.

CASE V (A150733) —J. M. P., a laborer on the road, sixty-five years of age, married forty-four years, four children. The urinary difficulty consisted in smarting on urination for the previous three years. Examination per rectum revealed a median enlargement of the prostate. The blood-pressure was 128-86, 135-95. Urinalysis



750 c c in 12 hours, specific gravity 1028, otherwise negative. There were 2 to 3 ounces of residual urine. Phthalein test A showing in ten minutes, 35 per cent in two hours, second test, a showing in fifty minutes, 50 per cent in two hours. Blood urea 30 mgs in 100 c c and 42 mgs in 100 c c. In spite of the good renal function, it seemed best to make a suprapubic drainage before removing the prostate, as the patient was not in a good general condition. No reaction followed the drainage of the bladder, and about three weeks later a suprapubic prostatectomy was performed. The temperature was 100° on the second and third days following the operation, but was not above normal at any other time during the convalescence, and the patient was discharged on the nineteenth day with his wound healed.

Examination of the blood at the time the operation for drainage was performed showed 85.3 per cent polynuclears and 22,400 leucocytes. Five days later there were 80.3 per cent polynuclears and 13,000 leucocytes. At the time of the prostatectomy there were 61.7 polynuclears and 18,000 leucocytes.

Bacteriologic examination of the urine at the time of the operation for drainage of the bladder showed pneumococcus on the blood-agar culture, but there was no growth on the other media. Before any treatment had been instituted, glucose-agar, bouillon, and anaerobic cultures were all sterile for four days. Four days after drainage of the bladder an agar culture showed staphylococcus, streptococcus, and *Bacillus coli*. A staphylococcus, gram-negative saprophytic organism was found on anaerobic culture. Bouillon culture showed streptococcus and staphylococcus and a gram-negative bacillus. At the time of the prostatectomy, glucose agar, blood agar, anaerobic cultures, and bouillon showed *Bacillus coli* and pneumococcus. Glucose agar, blood agar, bouillon, and anaerobic cultures of the urine four days after prostatectomy showed pneumococcus and *Bacillus coli*.

A glucose-agar culture of material taken from the wound four days after the prostatectomy showed large gram-negative saprophytic bacilli, probably saprophytes.

In spite of the fact that many organisms were present in these cultures, the patient showed no evidence of infection at any time and made a prompt recovery.

## PROSTATECTOMY

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THE selection of cases for prostatectomy is far more important than is the method of approach. The unavoidable complications of the operation, including pneumonia, pulmonary embolism, acute dilatation of the heart, and cerebral embolism, should exceed in number the common causes of death, of which the most frequent are uræmia, hemorrhage, sepsis, acute renal infections and apoplexy. The incidence of pulmonary congestions and infections will probably remain unchanged, although some benefit may be expected to follow careful regulation of the hygienic regimen and judicious selection of the anæsthetic. The decision for or against prostatectomy in cases in which the probabilities of prolonged comfort with catheter life are great, may depend upon the presence or absence of emphysema, bronchiectasis, chronic bronchitis or tuberculosis. Pulmonary complications of such gravity as the aforementioned are clear contra-indications to operation, provided the patient can find reasonable comfort in non-operative measures.

Obstructions of the lower urinary tract give rise to early destructive changes in the kidneys through alterations in the mechanics of urinary excretion. The renal changes, serious in themselves, give rise secondarily to cardiovascular and metabolic disorders, and the resultant invalidism renders the subjects of the associated pathology hazardous risks in major surgery. In addition to these chronic, and to a certain extent, irremediable changes in the cardiovascular and renal systems, the almost invariable presence of urinary infection adds another source of potential danger in the surgery of prostatic obstruction. At least 75 per cent of the patients who present themselves for prostatectomy have an infected bladder, and in a considerable number the infection has invaded the upper urinary tract as well.

Infection in these cases is often beneficent in that its prolonged residence in the urinary tract has created a certain immunity on the part of the tissue, thus minimizing the danger of severe post-operative inflammation. In other instances the infection has already become widespread and has added its influence to back-pressure in renal destruction. In a third group of cases the inflammation, although localized to the lower urinary tract, has been so severe in its manifestation and has given rise to so much discomfort that the vitality of the patients is almost exhausted when they come to the surgeon. The average case presents not only a combination of the foregoing

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processes which may be said to depend upon the urinary obstruction, but in addition his vital organs show the scars of the battle of a life almost spent. The degree of myocardial degeneration, arteriosclerosis and of chronic nephritis dependent upon ancient inflammations, and entirely independent of the obstruction at the vesical outlet, must be sought for and their probable influence in functional crippling ascertained.

The prostatic is therefore primarily a complex problem for functional study, a problem whose solution is the determination of the maximum reserve power of his vital organs. Ordinarily these patients have already drawn heavily upon their reserve function before operation is considered. Furthermore, it is safe to assume that there will be no further utilization of reserve power during the pre-operative time interval spent in the hospital. It is likewise fair to assume that the prostatic has reached the lowest ebb of vital function, that he will experience, barring, of course, the cases that are moribund when they come for hospital treatment. It is therefore the duty of the surgeon to ascertain by various tests and examinations the level of descent of vital activities representative of the lowest "ebb" of function, and so to treat the patient that the highest "flow" of function will be attained and maintained before attempting enucleation of the prostate. In no instance, however physically fit the individual may seem to be, is operation justifiable until these studies have been completed.

Before taking up the question of surgical treatment of the different classes into which these cases group themselves, we will consider briefly the means at our disposal for determining the vital reserve powers and the therapeutic measures useful to increase them.

The individual who passes a normal quantity of normal urine, that is, physically and chemically normal, is possessed in the majority of instances of kidneys that are surgically sound. Unfortunately, this is rarely seen in patients with prostatic enlargement. The chemical analysis of the urine of these patients, while important as an index of renal function, lacks the ease of determination and the accuracy of the phenolsulphonephthalein test. As an index to the capacity of the kidneys to excrete solids we have in this drug a means that is extremely simple in its application and one of the most accurate laboratory tests in general. A wealth of clinical experience confirms the original findings of Rowntree and Geraghty,<sup>1</sup> and the phthalein test is, at this time, one of the important means of determining the degree of renal function. We have learned to depend upon the urea nitrogen content of the blood as indicative of the renal activities. This test, while of great value and of the same significance as the phthalein test, is less applicable than the latter as a routine measure. The result of either test may be compared with that of the other, thus minimizing the dan-

<sup>1</sup> Rowntree and Geraghty. *Jour. Pharm. and Exper. Therap.*, 1910, 1, 579.

ger of misinterpretation The indigo-carmin test is used frequently and always in connection with the two foregoing when there is any doubt

The first estimation of renal function is made soon after the patient's admission to the hospital and, if possible, at the time of the first catheterization when the amount of residual urine is also determined If the appearance time of the drug is delayed (over 15 minutes) and the total output is diminished (50 per cent or less), preliminary treatment suitable to the case is instituted This will depend primarily upon the amount of residual urine present and the degree and activity of an existing infection Cases with large amounts of residual urine, especially those that have never been instrumented, are poor surgical risks when operated upon immediately after the initial instrumentation With the relief of back-pressure on the kidneys incident to the sudden decrease of intravesical pressure a marked renal congestion occurs that, with the added irritation of an anæsthetic, may send there apparently favorable cases into uræmia

Cystoscopic examinations are a source of great danger in impending uræmia They should be performed only after it has been ascertained that a state of relative renal efficiency exists In no instance should prostatectomy be attempted after a cystoscopic examination until the influence of this seemingly benign procedure on the kidneys has been determined

It is our practice, as mentioned above, to contrast the results of the phthalein test with the urea nitrogen content of the blood The elimination of the latter is a specific renal function, and abnormal retention of urea (over 0.35 per 1000 c.c. of blood, Tileston & Comfort) has the same significance as a low output of phthalein These two tests have proved themselves in our experience of almost equal value In cases with advanced secondary symptoms, including anæmia and loss of weight and strength, the determination of the alkaline reserve of the blood plasma (acidosis), as indicated by the hydrogen ion concentration of the blood and the carbon dioxide content of the alveolar air, is made Marked degrees of acidosis precede the onset of uræmia, but aside from this, convalescence after prostatectomy is invariably uncertain when marked retention of acid salts exists

Having demonstrated a low state of renal function, it becomes necessary to ascertain its cause or causes The relief of back-pressure on the kidneys following the institution of catheter treatment generally results in increased kidney function An increased output of phthalein is noted, and this improvement progresses to a point where the percentage output of the drug becomes stationary If this maximum of elimination is well beyond the low normal level, the subject is generally a good one for prostatectomy If, on the other hand, the output of the drug increases under appropriate treatment to a cer-

tain extent but the improvement stops at a subnormal level and persistently remains there, further cause for the renal defect than back-pressure must be sought for

Antecedent chronic nephritis, independent of the effect of low urinary obstruction, sometimes is an important consideration. This is determinable only by exclusion. Frequently the renal inefficiency is dependent upon the cardio-renal lesion with the cardiac factor predominating. The latter may be of valvular origin but is more often due to chronic myocardial degeneration. Cardiac decompensation, dependent upon weakening changes in the musculature of the heart, is a serious complication that offers little or no hope of complete restoration, with few exceptions, however, these patients may be improved to the extent that prostatectomy may be safely attempted. Prolonged medical treatment is necessary, and the best index of improvement is the gradual decompression of the kidneys as measured by the phthalein output.

High arterial tension becomes a complicating factor in the minority of cases. This generally improves coincidently with increased renal elimination, but in certain instances a persistent high blood pressure calls for specific treatment. Free catharsis suffices in the mild cases, drug therapy designed to lower the pressure is rarely permissible. In pre-uræmic states bloodletting with transfusion, hypodermoclysis or saline by the bowel will bring immediate results in the majority of instances. Diuretic drugs, including spartein, sulphate, caffeine, and potassium citrate, are probably harmless and may be of some value.

In cases of acidosis sodium bicarbonate should be administered by mouth until the urine becomes alkaline in reaction. Severe degrees of the condition call for infusion of sodium bicarbonate solution. The administration of glucose solutions by proctoclysis is a valuable adjunct in profound states of acidosis.

It is evident from the foregoing brief account that we have lately acquired valuable means of determining the operability, the temporary inoperability and the permanent inoperability of vesical obstruction. The tests are of greatest value as indexes of the improvement expected to follow pre-operative treatment. Experience has taught us that prostatitis fall into more or less clearly defined groups depending upon the local condition of the lower urinary tract and upon the degree of renal and cardiac defects. In addition we have learned that certain specific forms of treatment before operation are indicated to bring each group to the point of maximum resistance.

*Group I* may be made to include those cases of early prostatic hypertrophy that present few subjective signs, in which the bladder capacity is approximately normal with small amounts (less than 150 c c) of infected or non-infected residual urine, a normal phthalein output, and no serious organic defects in the heart or blood-vessels.

Cases of this kind may be operated upon when the patients have become acclimated to their hospital surroundings, when the various tests have been carried out and after a cystoscopic examination has been made without deleterious after effect

*Group II* includes cases in a later stage of prostatism with or without marked secondary systemic symptoms. Patients in this class are subjectively ill. The prominent symptoms are frequency of urination, dysuria and hæmaturia. Examination shows the presence of large amounts of residual urine which may or may not be infected. The bladder walls are atonic and diminution in kidney function dependent almost entirely upon back-pressure is disclosed. Patients belonging to this group are often fair surgical risks at the outset and will become excellent risks with the institution of proper pre-operative treatment. The latter is designed primarily to relieve back pressure, to bring about renal decompression. The question now arises shall we attempt the relief of the kidneys by intermittent or permanent catheterization, or shall we drain the bladder suprapubically, thus dividing prostatectomy into a two-stage operation. It is our practice in dealing with the mild cases in which the amount of residual urine is small first to try intermittent catheterization with sufficient frequency to keep the bladder empty. If under this form of treatment the phthalein output rapidly increases, no further preliminary treatment designed to relieve back-pressure is considered necessary. The permanent catheter, which formerly held such a prominent place in our pre-operative treatment of prostatics, has been practically abandoned. Its use is reserved for cases of such severity that the simple operation of suprapubic cystostomy is contra-indicated. The presence of a catheter in the urethra is so often ill-borne in cases where an intense cystitis exists, and, in our cases, the frequency of epididymitis, complicating its employment has been such, that we have adopted suprapubic cystostomy in the majority of instances where previously an indwelling catheter was employed. There is, however, a definite group of cases in which the gradual diminution of back-pressure on the kidneys or improvement in the cardiac condition is necessary before the operation of cystostomy is permissible. In these cases the indwelling catheter has a definite field of usefulness.

*Group III* includes cases in which a small, contracted, severely ulcerated bladder gives rise to distressing symptoms. The existing infection has generally invaded the upper urinary tract and pyelitis, pyelonephritis or pyonephrosis are serious complicating factors. Hydro-ureter and hydronephrosis are concomitant associates in certain long-standing cases where the infection is confined to the bladder. The obstruction at the vesical neck in cases belonging to this group is frequently of the stricture variety and of inflammatory origin, or if the obstructive factor is an adenomatous mass, it is usually of the horse-

collar or ball-valve type. The bladder contains little or no residual urine. These patients bear instrumentation badly and epididymitis is a frequent complication. On account of hematuria, urinary distress and toxæmia, of both bacterial and renal origin, the vitality of the patients is at a low ebb when they first present themselves. This group offers the least chance of operative cure, and prostatectomy is not infrequently a complete failure even as regards symptomatic relief. Attempts should be made to improve the general condition along the lines already suggested, and in this effort sedatives and tonics play an important part. Despite the most careful treatment it often becomes necessary to drain the bladder at a time when under other circumstances prolonged pre-operative treatment would be advisable. The mortality in this group is high and the morbidity dependent upon operative complications is great, fortunately this group comprises the minority of cases. The differential diagnosis between this variety of vesical obstruction, vesical tuberculosis and carcinoma, of either prostatic or bladder origin, is oftentimes made with great difficulty.

There are many gradations between the clear-cut clinical pictures of the foregoing groups, each case is more or less a clinical entity and should be treated as such. The general application of the principles of pre-operative treatment outlined above will serve, however, to illustrate the plan of treatment to be employed in the individual case as it approaches one or the other of these groups.

I have already remarked the increasing frequency with which we are adopting the two-stage operation and have, in a general way, defined the indications for preliminary suprapubic cystostomy. The two-stage procedure is now employed in all cases where catheterization fails promptly and permanently to relieve the effects on the kidneys of back-pressure. This method is likewise employed in all cases, regardless of the ease or difficulty of improving kidney function by other means, where an active urinary infection exists. Finally, it is our method of choice in that considerable group of cases where doubt exists as regards the ability of the patient to withstand the one-stage operation of suprapubic prostatectomy. It has been our experience that the two-stage operation by the suprapubic route is the safest and surest way to relieve obstruction at the vesical outlet.

The patient is operated in the Trendelenburg position. The preliminary cystostomy may be done under infiltration anæsthesia, although I never use it. In the absence of definite contra-indications the use of ether by the drop method, gas-oxygen, and occasionally, for example, a patient with a very high blood-pressure, chloroform. Intraspinal anæsthesia is rarely used, we regard it a dangerous anæsthetic.

The prevesical region is exposed through a right rectus muscle splitting incision. The incision is placed over the lower, inner border of the muscle, care being taken to avoid the midline. It should be of

## PROSTATECTOMY

sufficient length to give ample exposure of the bladder. The two portions of the muscle are retracted laterally, and a small piece of gauze placed in the upper angle of the wound. The piece of gauze with the upper angle of the wound is retracted upward, this piece of gauze also serves the purpose of protecting the peritoneum against injury, at the same time putting the prevesical tissue on the stretch, thus rendering further dissection more certain. The prevesical tissue is cut through, not torn through or scraped away, by blunt dissection or with gauze. The veins in the prevesical tissue are avoided, if possible, and, if not, are cut and ligated. The bladder wall is now exposed and grasped or steadied with a pair of small tissue forceps, and cut through as near the summit as possible, when a pair of retractors is introduced into the bladder, and traction made laterally. The cavity of the bladder is now mopped dry with small pieces of gauze, palpated and inspected, stones are sought for and if found removed and careful inspection of the prostate made. A rubber drainage tube one-quarter to one-half inch in calibre with a lateral opening in the lower end is introduced into the bladder and carried down to provide perfect siphonage of the bladder cavity. The bladder wound is closed up to and close to the tube when it is anchored by an iodine catgut suture passed through either half of the rectus and bladder wall, and the suture tied down upon the rectus beneath the anterior sheath. The margins of the incised prevesical fatty tissues are brought together with interrupted iodine catgut sutures, a small piece of rubber dam is placed in the prevesical space and the wound of the soft parts closed. The tube is held in position by carrying a silkworm-gut suture through the skin and anterior sheath of the rectus muscle as well as through the side of the tube.

Before tying the latter suture, the siphonage should be tested by introducing a fluid through the drainage tube, and unless it is perfect the silkworm sutures must be removed, the tube must be either raised or placed at a deeper level. The anterior rectus sheath is closed with a running iodine catgut suture and the superficial wound closed with one or two through-and-through silkworm-gut sutures, including the anterior sheath. The wound is dressed and the patient returned to bed.

Preliminary drainage of the bladder is continued until the maximum physical efficiency of the patient is demonstrated by the various tests, already described, which is usually about two weeks. Enucleation is done under ether or gas-oxygen anæsthesia, occasionally chloroform. In a patient with high blood-pressure, we rarely use spinal anæsthesia. The original ventral incision is reopened above and below the drainage tract to the extent necessary to permit free manipulation within the bladder. During the time of healing after the performance of the first stage of the operation the prevesical and perivesical tissues adjacent to the incision have become fibrosed and their contained lymphatics



obliterated. The healthy tissues are in this manner walled off from the operative field of the second stage of the operation. Care should be taken not to break through this protective barrier. The opening into the bladder is enlarged if necessary. In cases with marked intra-vesical projection the enucleation is begun by tearing through or, in some instances, by cutting through the thin mucous membrane overlying the most prominent lobe. In other instances the dissection is begun in the urethra after the method of Squier, the line of cleavage between the adenomatous masses and their sheath being sought for through the roof of the prostatic urethra anteriorly. In the majority of instances in which the hypertrophic enlargement of the prostate projects itself into the bladder, the sphincter muscle has been pushed aside and is in little or no danger of injury during an enucleation begun from the vesical aspect after the method of Freyer. Where the most prominent nodules present themselves in the urethra, the method of Squier has the advantage that the sphincter is in less danger of injury than with the Freyer method.

Hemorrhage immediately following prostatectomy is usually due to incomplete removal of the encapsulated mass, for the same reason that retained secundines cause uterine bleeding. In both instances natural hæmostasis is prevented because of the impossibility of firm contraction of the muscles surrounding the cavities. In the event of profuse hemorrhage immediately following the extraction of the gland that is not easily controlled by pressure temporarily applied, it is my practice to enlarge the wound sufficiently to give free access to the prostatic bed. A pursestring or overrunning suture of plain catgut is then placed in the mucous membrane forming the margins of the cavity which is then packed firmly with a single strip of gauze, the free end of which projects through the parietal incision through the bladder wall alongside the drainage tube. The pursestring or overrunning suture is then drawn taut and is tied. Uncontrollable hemorrhage has been unknown in our work since the adoption of this simple procedure.

The different technical steps in the operation will vary with the several types of obstruction. In those cases dependent upon sclerotic changes in the region of the vesical neck and in which total enucleation of the prostate is indicated, we prefer the perineal avenue of approach. When the indications exist for the removal of an obstructing bar, or where sclerosis of the bladder orifice indicates the necessity of excision of a wedge from one or more points in its circumference, we much prefer to do the work through a suprapubic opening under the guidance of the eye, and with a rongeur forceps or a pair of Sir Henry Thompson's prostatic forceps.

Suprapubic prostatectomy is as safe a procedure in expert hands as is the infrapubic operation. In the hands of those of little experience

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the suprapubic is far safer than the infrapubic operation. Fistula, incontinence of urine and failure to relieve the obstruction at the vesical outlet are frequent complications of the infrapubic operation that should be practically unknown following the suprapubic operation.

It is my practice in a large percentage of cases to make a circular incision through the mucous membrane and the overlying prostatic sheath around the vesical orifice of the urethra and carry my enucleation through this gutter which, when completed, does not make any irregularities of the mucous membrane, such as have been known to offer subsequent obstruction and require removal in order to restore function.

Rigid adherence to the modern principles of pre-operative treatment is of greater importance, however, so far, at least, as immediate mortality is concerned, than either the method of approach or the technic of its execution.

## SOME FURTHER DATA ON ARTIFICIAL IMPACTION OF THE HIP<sup>1</sup>

BY FREDERIC J. COTTON, M.D.  
OF BOSTON, MASS.

I PROMISED a bit more than I can fulfil, namely an account of results (including my more recent cases) of artificial impaction in loose hip fractures within the joint, and I must ask your forbearance if I only do the best I can, and report those cases on which I have data on hand, and such data as I have on hand.

First, may I say that I am more than ever convinced that the average result of our hip fractures has been entirely misunderstood and, therefore, misstated. I believe that the cases treated in our general hospitals here (and there is no reason to believe us peculiarly accursed) will show well under two-thirds, probably under one-half, of functional good results,—anything anywhere near restoration of walking power in hip fractures in all adults (to say nothing of the aged) whether intra- or extracapsular in type.

The failure to accomplish results in the extracapsular fractures of the neck has been one purely of failure to understand the situation and to meet it by adequate care of reduction and in after-treatment.

So far as I have been able to learn from my own cases and from many others, seen or read of as reported by other men, I can only conclude that non-union in these cases is a negligible factor,—that the question is only that of fixation carried out in such a way as shall insure reasonably accurate reposition of the fragments and that avoidance of adductor contracture which is so important a part of the after-treatment not only of hip fracture, but all lesions of the hip joint. Apparently adduction contracture is an important, if not the chief factor in the disability of most hip injuries that do badly.

Whether this feature is best to be combated by the method of Phillips, Maxwell and Ruth,—the method of traction in abduction combined with lateral traction,—or by the method for which Whitman has made large and repeated claims—fixation in abduction after manipulation or by Moore's scheme of abduction in flexion in the so-called "frog-spica" which of these is the best in this particular class of cases I do not feel that I am qualified to say.

I have used the first method once with success.

I have used the second and third repeatedly.

Whitman's method, *in this class of cases*, has given poor reduction, with overlapping of fragments—in two cases. In the others of this class it has worked out well.

Moore's method has a very definite advantage in that one may "sit up" these patients without mechanical damage—*immediately*.

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\* Read before the American Surgical Association, June 2, 1917.

It has the *disadvantage* of involving flexion of the knees, and in all my cases, including artificially impacted fractures and open operations as well as simple extracapsular fractures, there has been a good deal of trouble after use of this spica in "limbering-up" the knees of the stiff old people who in practice are the ones who break their hips

All these cases have eventually done very well, and I think that if we are to adopt abduction as a schematic treatment, for *extracapsular* fractures, abduction should be abduction in flexion; but I am a bit uneasy about recommending this for big hospitals, because the method, good as it is, requires an efficiency in after-care that can not always be secured

As to the intracapsular cases the situation is different

Among these some come to us already impacted by the fall that broke the bone, and in fair position

In these cases there are but two things to do—first, guard against adductor spasm and eventual contracture of the powerful adductors, second, minimize eversion. This does not necessarily mean forcible correction (loosening up of the impaction) but may be carried out as I have done it repeatedly, by gradual correction with sand-bags to the best position attainable in the given case, without spoiling the impaction

Whatever the treatment a certain number of these cases are going to lose out!

There is always marked absorption of the bone of the femoral neck in these cases

This does not occur in the extracapsular cases and varies very greatly in amount in different intracapsular cases

We have been familiar with this in the cases primarily unimpacted in which the absorption is very rapid, but we have not understood that the process is universally present nor have we understood its importance

In every case of intracapsular fracture, whether impacted or not, and even if it is only a crack, careful X-rays at intervals show an absorption with porosis of the bone and with shortening of the neck and often with a bending of the neck into coxa vara

Even if repair is fully satisfactory this occurs, along with the repair, if the bone-forming power is poor the softened bone fails to hold the impaction and it simply falls apart. I shall presently show a series of plates exemplifying this and I believe it to be common. Again and again I have looked up old hospital cases down in the records as impacted and with X-rays that I accepted as showing impaction, in which the hip proved to be loose when I found them a year or two later. Most of these were the others fellows' cases often sent out in a month on crutches, but I have had this thing happen to two cases with apparently firm impaction while they were in bed under the best care I knew how to give them. I believe the occurrence is not unusual. It is an argument for long protection and late weight bearing in all these cases

I'm perfectly ready to have weight on the extracapsular cases at two months but have made it a rule to have the intracapsular cases whether

impacted by accident or by me kept in plaster three months, no weight for four months, and full weight only at six months

And even at this I know I am going to have failures

What we need is to know what happens to our cases So far from their all doing well, I think the intracapsular cases in particular do badly under ordinary treatment in a majority of the cases, and shall continue in this belief till somebody comes across with end-results figures to match the assurance that "they all do well under my system"

They do not under any system

Now as to the impaction proposition

It concerns itself only with a small class of broken hips, namely, with the intracapsular or subcapital fractures, the fractures of the neck proper—whatever you choose to call them—in which there is no impaction present or in which the deformity, especially the eversion deformity, is extreme

The operation puts these cases into the much more fortunate class of firmly impacted fractures in improved, often in perfect, position

They are then to be treated exactly like the cases of accidental impaction, and are of no better prognosis save that the average position is much better and the impaction perhaps firmer

Many of my friends say that artificial impaction is impossible and that I do not do it I can only say that some of you and a good many other competent surgeons have seen the thing done—very skeptical some of them were, too, and they have without exception been convinced of the fact that it can be done—irrespective of course of the natural difference of opinion as to whether it should be done

Now as to the cases, I have had but eleven cases since the last report

CASE I—A case in a woman of sixty, operated on for Bapst Blake seven weeks after the injury, operated on, I confess, partly to demonstrate the method at the time I showed some end-results before the Clinical Congress of Surgeons here in October, 1915, without great hopes of success so long after the injury The impaction seemed to be successful, the foot no longer flopped outward, and the trochanter moved in the long arc, not on its own centre This was verified by Murphy, Peck and others of our fellows Position was maintained well until discharge After that she had only the care possible in a well-managed pauper institution The clinical result is nothing to boast about The woman is old, broken, and feeble Whether the result here is a bony or a close fibrous union is perhaps debatable In either case I submit that it is much better than one gets in untreated unimpacted cases

I do not feel, however, that my operation should be advised with any optimism in cases after three or four weeks—perhaps not after two weeks Smoothing off and cicatrization of the broken ends probably occurs early, and any impaction produced late is not the desirable mutual impaction of clean bone surfaces of full reparative power

CASE II—A woman of forty-two, operated at the New England Hospital for Women and Children This woman had advanced tabes

and various tertiary lesions. She fell, and broke her hip. I impacted it, and under the usual routine obtained a *bony* union, with little deformity or shortening. At the end she had very nearly the function limited by her old locomotor trouble.

CASE III—Mrs. M., aged fifty-six, operated on for Dr. Elizabeth Gray at the New England Hospital for Women and Children. A fresh case of entirely unimpacted hip fracture. I have no late X-rays of this case but I have seen her within the week. She can walk without support though she is apt to use one crutch or a cane if long on her feet. The shortening is just under an inch. Her disability is largely one of defective muscle power. The fracture is immobile and corresponds to all clinical tests of a bony union.

CASE IV—Mrs. G., aged sixty-three, operated on at the Cambridge Hospital, April 13, 1916, for Dr. August. A type case of loose fracture operated on as usual. She is now walking after a year, fairly well, with one crutch or a cane. The hip is solid and painless. The defect, such as it is, is one of muscle power.

CASE V—A. B., aged forty-eight, operated at the Cambridge Hospital, July 14, 1916, for Dr. Dudley. Usual case of unimpacted fracture, treated like the others. Impaction and position maintained for four months. Union apparently solid then. I have been unable to locate her to see the end result.

CASE VI—Mrs. N. C., aged sixty-two, operated for Dr. Horace Stevens at the Cambridge Hospital, June 21, 1916. A type case, operated on in the usual way. Seen May 28th, she had obviously firm bony union—a shortening of less than half an inch, over half the normal motion, and can walk. She is still using a cane.

What disability remains in this case is largely muscular.

The hip is solid.

CASE VII—Mrs. R., operated on at the Brigham, on request of Dr. Cushing, January 5, 1916. The usual findings and the usual procedure and after-treatment.

This case is interesting because we can trace the bridging across by bone of part of the defect that long continued fibrous. In this case the woman showed, at fifteen months, excellent function and bony union.

CASE VIII—M., operated for Dr. Blake. Reduction and impaction went well. End result not known. Went "O. P. I." to the city hospital on Long Island.

CASE IX—Operated for Dr. Blake. Everything all right up to discharge. Went to the city hospital on Long Island. End result not ascertained.

CASE X—S., old broken man of sixty odd. Probably not a fit case for operation. Reduction and impaction went well, but after removal of the spica at three months the limb gave way, there was not even an attempt at union.

CASE XI—Mrs. McG., aged sixty-five, looking at least ten years older. Operated for Dr. Harvey Cushing. Type case, type procedure, December 6, 1916. Reduction excellent, but absorption unusually great. Up to February 21st the cast was kept on—two and 2

half months The skiagraph a week later showed the impaction still obvious After another week the coxa vara had increased, but the impaction seemed still serviceable April 24th, at four and a half months, the impaction had entirely given way, despite all care This case was a failure Whether harder impaction or better after-care would have done better, I do not know

CASE XII—A woman of fifty-eight Type case Operated on December 23, 1916, with the type of procedure as usual Reduction was satisfactory, and everything looked favorable enough until she died after twenty-one days of myocarditis

CASE XIII—Mrs McD, aged sixty-nine, type case Usual operation December 23, 1916 This case has gone on well, though, perhaps because she was extremely fat about the hips, I did not get as good a position as usual She is still at the Newton Hospital, and is beginning to walk about fairly well with a crutch Union has not given way, and I expect her to regain pretty near full function

Now this series chances to be almost entirely of cases operated on for others at outlying hospitals, and in most instances under circumstances precluding the after-care as to massage and passive motion that means so much in the regaining of function

As to functional results this series leaves a good deal to be desired

As to anatomic results, it shows that artificial impaction may give way months afterward, just as accidental impaction does in individuals whose bony, as well as general, nutrition is low

Both the cases in which this happened were very old and feeble But I submit that this series does support my contention that the unimpacted cases can be reduced and can be impacted so as to give them at least the chance of good results normally due in case impaction is originally present

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## THE HANDLING OF EARLY AND DOUBTFUL CASES OF CANCER\*

By ROBERT B GREENOUGH, M D  
OF BOSTON, MASS

IN January, 1917, the Cancer Commission of Harvard University offered to supply to the medical profession of Massachusetts the services of their laboratory for the free diagnosis of suspected cancer tissue. This offer was made at the instigation of the Committee on Cancer of the Massachusetts Medical Society, and was in accordance with the movement which originated in the American Society for the Control of Cancer for the provision of facilities for free diagnosis of cancer tissue, throughout the country, and based upon the report of a Committee of that Society composed of Dr James Ewing of Cornell, Dr F C Wood of the Crocker Fund, and Dr L D Bristol, published in the *Journal of the American Medical Association*. In that report the concluding recommendation "D" reads as follows: "Judgment must always be used by surgeons in the removal of cancerous tissues for diagnosis, and the value of the microscopic diagnosis should appear to outweigh the risk involved before such a procedure is adopted." I fear that the wise caution here expressed has not always been followed in the removal of tissue for diagnosis.

The offer of free laboratory service was made to the Health Commissioner of Massachusetts, and was accepted by the Health Commissioner, Dr A J McLaughlin, subject to the issue of such rules and suggestions, to be issued to the profession at the time of the announcement of the service, as should be deemed advisable by the Commissioner of Health and by the Cancer Commission of Harvard University.

In the preparation of these rules and suggestions the writer at once became aware of the fact that a considerable part of the medical profession held strong views, and views which were not always in agreement, upon the subject of the propriety of the excision of fragments of tissue for pathological diagnosis in cases of suspected cancer. At about this time the announcement of a similar service for the free diagnosis of pathological material was made by the Health Commissioner of New York City, and a storm of criticism immediately arose in the medical publications of that city. Under these circumstances the writer ventured to prepare the circular letter dated March 20, 1917, copies of which were sent to all of the fellows

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\* Read before the American Surgical Association, June 2, 1917



of this Association, and to the members of the Clinical Surgical Society, the American Gynæcological Association, the members of the American Association for Cancer Research, and the Directors of the American Society for the Control of Cancer The letter is as follows

10 GLOUCESTER STREET, BOSTON

March 20, 1917

DEAR DOCTOR

The American Society for the Control of Cancer has placed itself on record as favoring the institution of free diagnosis of pathological material throughout the country In so far as this movement provides for the examination of material removed by radical operations, performed for the cure of cancer, there is no room for adverse criticism So far, however, as it applies to the excision of small pieces of suspected tissue in order to establish a diagnosis, its wisdom has been the subject of some discussion This circular letter is sent to the members of the American Association for Cancer Research, the American Surgical Association, and the American Gynæcological Association, in order that a collective opinion in regard to the safety of procedure in specific cases may be obtained Will you be kind enough to state whether or no you approve of the procedure indicated in the following list of lesions, and if you do not approve, will you be kind enough to state your opinion as to what procedure should be recommended? Please bear in mind the fact that an immediate frozen section diagnosis of suspected material is not in question, but that these recommendations have to do with the removal of suspected tissue, and its shipment to a laboratory, for diagnosis, involving a delay of at least a week before the pathological report can be obtained Bear in mind, also, that the question has to do only with early and doubtful cases in which a positive diagnosis of cancer cannot be established with sufficient certainty to justify radical operation

Trusting that the importance of the matter justifies the amount of trouble involved in answering these queries and with cordial thanks for your co-operation, I am

Very truly yours,

ROBERT B GREENOUGH

#### PROCEDURE RECOMMENDED IN THE DIAGNOSIS OF EARLY AND SUSPECTED CANCER OF DIFFERENT ORGANS

(1) *Lesions of the external skin* If small, complete excision of the lesion If large, excision of a portion of the growing edge of the lesion, followed by cauterization

(2) *Lesions of the lip* If small, V excision, with a good margin, of the whole lesion If large, excision of a portion of the growing edge of the lesion, followed by cauterization

(3) *Lesions of the tongue* Excision of the whole lesion, or if large, excision of a portion of the growing edge, with cauterization

(4) *Lesions of the palate, tonsil and the buccal mucous membranes* Excision of the margin of the lesion, and cauterization

(5) *Lesions of the œsophagus* Œsophagoscopy, and excision of the margin of the lesion

(6) *Lesions of the stomach* Pylorotomy, gastrectomy, or primary gastro-enterostomy, to be followed at a later operation, if necessary, by gastrectomy

(7) *Lesions of the small intestine and colon* Excision, with anastomosis

(8) *Lesions of the gall-bladder* Cholecystectomy

(9) *Lesions of the liver* If cancer, generally secondary to cancer elsewhere Exploratory excision rarely necessary or advisable

(10) *Lesions of the rectum* Excision of a portion of the growing edge of the lesion, with cauterization

## EARLY AND DOUBTFUL CASES OF CANCER

- (11) *Lesions of the kidney* Nephrectomy
- (12) *Lesions of the bladder* Cystoscopy, and excision of a portion of the lesion
- (13) *Lesions of the prostate* Prostatectomy
- (14) *Lesions of the testicle* Orchidectomy
- (15) *Lesions of the cervix of the uterus* (a) Excision of the lesion, (b) amputation of the cervix, (c) excision of a fragment of tissue, with cauterization
- (16) *Lesions of the fundus of the uterus* Curettage
- (17) *Lesions of the ovary* Oophorectomy
- (18) *Lesions of the breast* Local excision of tumors of the breast suspected of being malignant and submission of the tissue for subsequent pathological report cannot be recommended. If direct incision with frozen section diagnosis is not possible, amputation of the whole breast with dissection of the axilla should be performed in suspected cancer in women over thirty-five years of age
- (19) *Lesions of the lymph-nodes in the neck, axilla, and groin* A block dissection of the area involved, including the adjacent lymph nodes, is to be recommended in preference to the excision of a single suspected node
- (20) *Sarcoma and obscure tumors deeply placed* Exploratory removal of tissue for subsequent pathological examination cannot be recommended. Facilities for direct exploration and frozen section diagnosis should be secured, before radical operation, such as amputation, can be justified
- (21) In general, superficial and ulcerated lesions may safely have fragments of tissue removed, especially if a cautery is used to seal the lymphatics, whereas in deep tumors, where the exploratory excision necessarily opens up normal tissue to infection, exploratory excision, unless followed immediately by operation at the same sitting, is to be condemned

The writer would here express his thanks to the many members of these societies who have been to the pains to read and answer the numerous inquiries in this circular letter. The subject appeared to be one of such vital importance to the general policy of the campaign to obtain better treatment for cancer cases as to justify the attention and effort of those best suited to give expression to authoritative opinion. The response to the questionnaire has been most gratifying, and it is to announce and to discuss the opinions thus obtained that this communication has been prepared.

As was stated in the circular letter, the use of the immediate frozen section diagnosis of suspected tissue was not submitted for discussion. It is quite beyond the possibilities for such service to be rendered by any Cancer Commission or Public Health Laboratory. It must be provided, if at all, by the resources of the individual hospital or operator. In general, it may be said that the immediate frozen section diagnosis of suspected material offers, probably, the least dangerous method of obtaining light on the diagnosis of cancer tissue—that is, least dangerous to the patient as regards the artificial spread of the disease, but not, unfortunately, free from danger as regards the possibility of erroneous diagnosis. I have known the frozen section method to fail in such an instance as this. A breast suspected of being malignant is removed in toto, the pathologist present at the operation makes numerous sections of the tissue, and cuts frozen sections of the suspicious areas, no cancer is found, the operation (an incomplete one) is finished, without dissection of the axilla. After ten

days the pathologist discovers, in the routine paraffine section, that there is an area of cancer which escaped observation in the frozen section. The method is thus at fault in that it appears to give an accuracy that does not in fact exist. Such an occurrence as above detailed is probably known to many of you. It is the weak link in the frozen section chain, and must not be disregarded in estimating the value of the procedure.

When we speak of free diagnosis of suspected cancer tissue, however, we are speaking of the service which may be rendered by one or more central laboratories, involving the removal of tissue, placing it in tissue preservatives, sending it to the laboratory, and waiting for a certain length of time, say seven days, for a positive report. Under these conditions we must make up our minds when and where, if at all, the removal of fragments of tissue suspected to be malignant can be justified and recommended. One of the most widely accepted principles in the surgery of malignant disease is that cutting into cancer tissue leads to a spread of the disease. The proofs of the truth of this assertion are so common in the experience of every practising surgeon that examples are scarcely needed, but I may say that in my own experience not one case of cancer of the breast has been saved in which a primary local operation has been done under the erroneous diagnosis of a benign tumor, even when followed at an interval of seven to ten days by the most complete operation, when the pathological examination of the original tumor disclosed malignancy. With regard to other situations it is probable that the danger is not so great, but it is difficult to draw the line, and eighteen Fellows of this Association in their replies stand squarely by the general proposition that exploratory incision into cancer tissue is *never* justified. In this connection, however, it must be said that we are looking at this matter from the point of view of preserving the patient's chance, such as it may be, for a successful operation for the radical cure of the disease. Where we are dealing with a case of presumably inoperable cancer the same conditions do not hold. It is not then a matter of preserving the patient's chance for radical cure, it is, rather, a question of saving him a serious operation which may quite possibly be of no benefit. Under these circumstances the removal of a single node above the clavicle, and the pathological report that it is malignant, may save a useless operation for cancer of the stomach, or for hypernephroma. In this same category belong, I believe, many of the exploratory incisions for tumors of the cervical lymph nodes, where the diagnosis rests between tuberculosis, Hodgkin's disease, and carcinoma or sarcoma. If carcinoma or sarcoma, radical operation is probably out of the question, and the removal of a single node does little, if it is malignant, to hasten the end, and may give information of tuberculosis or Hodgkin's disease which will lead to appropriate treatment and beneficial results. In cases of this class the objections to the exploratory incision are obviously less than when the possibility of radical operation is still to be considered.

Before stating the replies, as they have been received, to the specific questions in regard to cancer in different situations, it is interesting to note

that consistency is just as rare a characteristic among medical men as it is among other human beings. We all have our principles, and we want to live up to them, but we rarely succeed in every instance. The exploratory incision into cancer tissue is, in fact, a confession of weakness—of the inability to make, from external signs and symptoms, a diagnosis of sufficient certainty to stand the crucial test of a mutilating operation. It is a curious and interesting fact that the individual surgeon advises the application of the exploratory incision chiefly in those cases with which he is least familiar, and where he finds it hardest to make an early but positive diagnosis. Most of us advise against exploratory incision in breast tumors, but think it sometimes permissible in cancer of the tongue. Many surgeons perform a total hysterectomy in preference to an exploratory excision of suspected cancer of the cervix, or in preference to a curettage for doubtful cancer of the fundus. When it comes to such mutilating operations as those for radical cure of cancer of the tongue, or jaw or larynx, however, we most of us want the support of a pathological report before the operation is undertaken in the doubtful cases, and yet the principle is the same, and the danger of the exploratory incision is probably just as great. It is in such cases as this that it is difficult to be consistent.

Replies were received from sixty-nine fellows of the American Surgical Association, forty-one members of the American Gynecological Association and twenty-four members of the American Association for Cancer Research and the American Society for the Control of Cancer—a total of one hundred and thirty-four letters. Not all were willing to commit themselves to a detailed expression of opinion, but the views expressed were invariably of interest, and many points were suggested for more detailed discussion.

Seventy-two out of seventy-three replies favored removal of the whole of any small suspected nodule of the external skin. Exploratory excision of a fragment in large tumors of the skin was approved by fifty-eight, but twenty-six objected to it as a dangerous procedure.

The replies in regard to suspected lesions of the lip and tongue were practically the same. All agreed that if small the whole lesion should be removed, if large, nearly one-third (29-80) of the replies expressed disapproval of the proposed removal of a fragment and cauterization of the wound.

When it came to the suspected lesions of the palate, those who disapproved of the exploratory excision were fewer in number, but they were very emphatic that the procedure was a dangerous one (24-57). This is undoubtedly due, in part, at least, to the grave prognosis of cancer of the palate under any conditions, for in suspected cancer of the œsophagus those objecting to the exploratory excision of tissue were still less in number (13), and some of them objected not on account of the spread of the disease but because of the danger of perforation.

When it comes to suspected cancer of abdominal organs, like the stomach, intestine, gall bladder, etc., the total removal of the suspected organ or

	Surgeons	Gynæcol- ogists	Pathol- ogists	Total
1 <i>External skin</i>				
(a) Small—excision				
Pro	59	11	2	72
Con	0	0	1	1
?	0	0	0	0
(b) Large—fragment				
Pro	32	15	11	58
Con	25	0	1	26
?	0	0	0	0
2 <i>Lip</i>				
(a) Small—whole				
Pro	57	12	11	80
Con	1	0	1	2
?	0	0	0	0
(b) Large—fragment				
Pro	29	7	10	46
Con	27	0	2	29
?	0	0	0	0
3 <i>Tongue</i>				
(a) Small—whole				
Pro	57	11	12	80
Con	0	0	0	0
?	1	0	0	1
(b) Large—fragment				
Pro	29	11	9	49
Con	27	0	2	29
?	0	2	0	2
4 <i>Palate</i>				
Fragment				
Pro	38	9	10	57
Con	20	1	3	24
?	2	1	0	3
5 <i>Œsophagus</i>				
Fragment				
Pro	37	10	6	53
Con	9	1	3	13
?	10	4	0	14
6 <i>Stomach</i>				
Whole				
Pro	56	15	10	81
Con	0	0	0	0
?	1	2	0	3
7 <i>Intestine</i>				
Whole				
Pro	59	19	10	88
Con	0	0	0	0
?	0	1	0	1
8 <i>Gall-bladder</i>				
Whole				
Pro	58	16	11	85
Con	0	1	0	1
?	0	1	0	1
9 <i>Liver</i>				
Pro	51	18	10	79
Con	7	2	0	9
?	0	0	0	0
10 <i>Rectum</i>				
Fragment				
Pro	37	16	10	63
Con	20	3	2	25
?	1	1	0	2
11 <i>Kidney</i>				
Whole				
Pro	56	20	9	85
Con	3	1	0	4
?	0	1	1	2

# EARLY AND DOUBTFUL CASES OF CANCER

	Surgeons	Gynæcol- ogists	Pathol- ogists	Total
12 <i>Bladder</i>				
Fragment				
Pro	39	18	8	65
Con	15	2	1	18
?	5	0	1	6
13 <i>Prostate</i>				
Whole				
Pro	52	11	6	69
Con	5	0	2	7
?	4	3	2	9
14 <i>Testes</i>				
Whole				
Pro	57	11	9	77
Con	2	0	0	2
?	0	3	1	4
15 <i>Uterus (cervix)</i>				
(a) Excision				
Pro	25	9	5	39
Con	28	22	7	57
?	2	0	1	3
(b) Amputation				
Pro	30	9	4	43
Con	22	21	7	50
?	0	0	1	1
(c) Fragment				
Pro	26	17	9	52
Con	26	15	2	43
?	0	0	1	1
(d) Cautery excision				5
16 <i>Uterus (fundus)</i>				
Curettage				
Pro	36	28	9	72
Con	12	7	3	22
?	5	1	2	8
17 <i>Ovary</i>				
Whole				
Pro	26	31	12	69
Con	1	1	0	2
?	2	1	0	3
18 <i>Breast</i>				
Whole				
Pro	50	21	9	100
Con	6	3	1	10
?	3	2	1	6
19 <i>Lymph-nodes</i>				
Whole				
Pro	47	17	8	72
Con	7	4	3	14
?	3	2	1	6
20 <i>Sarcoma</i>				
Whole				
Pro	54	19	9	82
Con	2	0	1	3
?	1	1	0	2
21 <i>General</i>				
Fragment or whole				
Pro	44	21	11	76
Con	9	0	1	10
?	5	1	3	9

## Cautery

Pro

Con

Number incomplete operations

Pro-biopsy in general

24

11

17

8

tissue is advocated in practically every case. This is undoubtedly due to the fact that the operation for cancer differs but little from that for benign lesions in its severity, or in the disability resulting.

In suspected cancer of the rectum, sixty-four are in favor of the exploratory excision of tissue, and twenty-five are vigorously opposed to that procedure—a number of conscientious objectors large enough to make us pause to consider whether their position is not well taken. About the same proportion exists in regard to the exploratory excision of tissue with the cystoscope in suspected cancer of the bladder—sixty-five are in favor, and eighteen are opposed to the procedure.

In tumors of the testicle and of the prostate, as might be expected, the removal of the entire organ is the procedure preferred in the great majority of the replies.

When it comes to cancer of the cervix of the uterus, the weight of opinion in favor of one or another procedure is not so clearly evident. Thirty-nine are in favor, and forty-seven are against simple excision of the lesion for pathological examination, forty-three are in favor, and fifty are opposed to simple amputation of the cervix, and fifty-two are in favor, and forty-three are opposed to excision of a fragment of tissue with cauterization of the wound.

In suspected cancer of the body of the uterus, seventy-two favor diagnosis by curettage, and twenty-two are opposed to this procedure, presumably on the ground that it may lead to dissemination of the disease. Twenty-five replies state that in suspected cancer of the uterus, a total hysterectomy should be performed at once, without waiting for the microscopic confirmation of the diagnosis—seventeen of these are fellows of the American Surgical Association, and seven of the American Gynecological Association. In general, the procedure in regard to cancer of the uterus may be said to be still a matter of discussion.

There is a general unanimity of opinion in favor of the total operation in preference to the exploratory operation in cancer of the ovary—sixty-nine to two, and of the breast one hundred to ten—and yet the differences of opinion here are very marked. One surgeon underlines the statement in paragraph 18: "Amputation of the whole breast with dissection of the axilla should be performed in suspected cancer in women over thirty-five years of age," and queries whether *anything* could do more to discredit the practice of surgery than this advice, while others express their hearty approval of this procedure, and suggest reducing the age limit to thirty- or even twenty-five.

Seventy-two agree, and fourteen disagree with the recommendation against the removal of single suspected lymph nodes, and yet eighty-two agree, and only three disapprove of the advice to avoid exploration in deep sarcoma.

Finally, seventy-six agree and ten disagree with the general recommendation that the exploratory removal of tissue be restricted to superficial and ulcerated lesions (to be followed by cauterization), and that it be

avoided in deeper tumors where the excision would open up normal tissues to invasion

In regard to the use of the cautery to seal the lymphatics after exploratory incision, opinion is not unanimous. Eleven are opposed to its use, chiefly on the ground that the hyperæmia resulting causes increased rapidity of growth. Twenty-five express themselves as favoring the use of the cautery in one or another situation as a safeguard against the spread of the disease. It has been the personal belief of the writer that the immediate occlusion of the lymphatics far outweighed in advantage any possible hyperæmia and consequent possible increased rapidity of growth which might occur at a later date.

To sum the matter up it may be said that the opposition to the use of the exploratory incision for the removal of tissue suspected of malignancy is very real. Many surgeons believe it is never necessary or advisable, others, and they are the majority, believe that in certain situations it is permissible when all other resources of diagnosis (in which should be counted the benefits of consultation) have been exhausted, and even then only (1) when the tumor is a superficial one, or (2) when a frozen section can be obtained immediately and the operation completed under one anæsthesia. Under these conditions, and under these conditions only, can the exploratory incision of the tumor tissue be justified as a reasonable surgical procedure. If exploratory removal of tissue is to be discountenanced what becomes of the project of the free diagnosis of suspected cancer tissue? I believe it assumes an importance greater than ever, because it should be applied to all pathological tissues removed for the cure of disease. The function should be a state function, and the report should go to the patient or his friends, as well as to the surgeon. It should be the final means of checking up the end-results of the surgical diagnosis and treatment of malignant disease. Only by some such drastic measures as this can the incompetent surgeon be prevented from depriving the patient of his one and only hope of cure of cancer by an early radical operation.

As a result of the analysis of the replies received a modification of the "Procedure Recommended in the Diagnosis of Early and Suspected Cancer of Different Organs" can be made, as follows:

1 Suspected, but doubtful lesions of the *external skin*. If small, complete excision of the lesion should be performed. If large, excision of a portion of the growing edge of the lesion, followed by cauterization, is to be advised only after all other resources of clinical diagnosis, including consultation, have been employed, and then only when facilities for immediate frozen section diagnosis are available and the operation for cancer, if it prove necessary, can be completed under one anæsthesia.

2 Suspected, but doubtful lesions of the *hp*. If small, V excision, with a good margin, of the whole lesion, should be performed. If large, excision of a portion of the growing edge of the lesion, followed by cauterization, is to be advised only after all other resources of clinical diagnosis, including consultation, have been employed, and then only when facilities for im-



mediate frozen section diagnosis are available and the operation for cancer, if it prove necessary, can be completed under one anæsthesia

3 Suspected, but doubtful lesions of the *tongue* Excision of the whole lesion, if small, should be performed If large, excision of a portion of the growing edge of the lesion, followed by cauterization, is to be advised only after all other resources of clinical diagnosis, including consultation, have been employed, and then only when facilities for immediate frozen section diagnosis are available and the operation for cancer, if it prove necessary, can be completed under one anæsthesia

4 Suspected, but doubtful lesions of the *palate, tonsil* and the *buccal mucous membranes*

If small, excision of the whole lesion should be performed If large, excision of the margin of the lesion, followed by cauterization, is to be advised only after all other resources of clinical diagnosis, including consultation, have been employed, and then only when facilities for immediate frozen section diagnosis are available and the operation for cancer, if it prove necessary, can be completed under one anæsthesia

5 Suspected, but doubtful lesions of the *œsophagus* Œsophagoscopy, and excision of the margin of the lesion may be performed, but the danger of perforation of the œsophagus must be borne in mind

6 Suspected, but doubtful lesions of the stomach, Pylorectomy, gastrectomy, or primary gastro-enterostomy, to be followed at a later operation, if necessary, by gastrectomy Here the difference in the severity of the possible operations for benign and for malignant disease is not sufficient to make an exploratory incision into suspected cancer tissue a necessary or advisable preliminary to radical operation

7 Suspected, but doubtful lesions of the *small intestine* and *colon*

Excision, with anastomosis Here the difference in the severity of the possible operations for benign and for malignant disease is not sufficient to make an exploratory incision into suspected cancer tissue a necessary or advisable procedure

8 Suspected, but doubtful lesions of the *gall bladder* Cholecystectomy Here the difference in the severity of the possible operations for benign and for malignant disease is not sufficient to make an exploratory incision into suspected cancer tissue a necessary or advisable procedure

9 Suspected, but doubtful lesions of the *liver* If cancer, generally secondary to cancer elsewhere Exploratory excision, or incision into liver tissue, is rarely necessary or advisable, except to confirm a diagnosis of hopeless malignancy, and thus avoid unnecessary radical operation

10 Suspected, but doubtful lesions of the *rectum* Excision of a portion of the growing edge of the lesion, with cauterization, is to be advised only after all other resources of clinical diagnosis, including consultation, have been employed, and then only when facilities for immediate frozen section diagnosis are available and the operation for cancer, if it prove necessary, can be completed under one anæsthesia

## EARLY AND DOUBTFUL CASES OF CANCER

11 Suspected, but doubtful lesions of the *kidney* Nephrectomy Here the difference in the severity of the possible operations for benign and for malignant disease is not sufficient to make an exploratory incision into suspected cancer tissue a necessary or advisable procedure

12 Suspected, but doubtful lesions of the *bladder* Cystoscopy, and excision of a portion of the lesion, with cauterization, is to be advised only after all other resources of clinical diagnosis, including consultation, have been employed, and then only when facilities for immediate frozen section diagnosis are available and the operation for cancer, if it proves necessary, can be completed under one anæsthesia

13 Suspected, but doubtful lesion of the *prostate* Prostatectomy Here the difference in the severity of the possible operations for benign and for malignant disease is not sufficient to make an exploratory incision into suspected cancer tissue a necessary or advisable procedure

14 Suspected, but doubtful lesions of the *testicle* Orchidectomy Here the difference in the severity of the possible operations for benign and for malignant disease is not sufficient to make an exploratory incision into suspected cancer tissue a necessary or advisable procedure

15 Suspected, but doubtful lesions of the *cervix of the uterus* (a) Excision of the lesion, (b) amputation of the cervix, (c) excision of a fragment of tissue, with cauterization Opinion is not conclusive Some advise hysterectomy on suspicion of malignancy This is undoubtedly radical, but preserves the patient her best chance of cure Others prefer the exploratory excision of tissue, or amputation of the cervix, to be followed immediately by the complete operation if frozen section shows cancer

16 Suspected, but doubtful lesions of the *fundus of the uterus* Curettage Opinion divided Some advise hysterectomy on suspicion of malignancy Others advise curettage and immediate frozen section diagnosis

17 Suspected, but doubtful lesions of the *ovary* Oophorectomy Here the difference in the severity of the possible operations for benign and for malignant disease is not sufficient to make an exploratory incision into suspected cancer tissue a necessary or advisable procedure

18 Suspected, but doubtful lesions of the *breast* Local excision of tumors of the breast suspected of being malignant and submission of the tissue for subsequent pathological report cannot be recommended If direct incision with frozen section diagnosis is not possible, amputation of the whole breast, with dissection of the axilla, should be performed in suspected cancer in women over thirty-five years of age This is endorsed by ninety per cent of the replies

19 Suspected, but doubtful lesions of the *lymph nodes* in the *neck*, *axilla*, and *groin*, in cases where radical operation is a possibility even if cancer is found to be present A block dissection of the area involved, including the adjacent lymph nodes, is to be recommended in preference to the excision of a single suspected node Where obviously a hopeless

case of cancer is shown to be present, removal of a single node may prevent a useless operation, and is to be recommended

20 *Sarcoma* and *obscure tumors* deeply placed Exploratory removal of tissue for subsequent pathological examination cannot be recommended Facilities for direct exploration and frozen section diagnosis should be secured in cases where doubt exists after X-ray studies and other clinical means of diagnosis are exhausted, before radical operation, such as amputation, is performed

21 In general, *superficial* and *ulcerated lesions* are the only ones in which fragments of tissue may safely be removed for microscopic diagnosis In deep tumors, where the exploratory incision necessarily opens up normal tissue to infection, exploratory excision of suspected tissue is to be condemned, and should be avoided Where other resources of diagnosis have been exhausted, an exploratory excision, with an immediate frozen section diagnosis, and immediate performance of the radical operation if it prove necessary, is the least dangerous procedure for the patient No suspected tissue should be excised for diagnosis, unless by a surgeon who is equipped to perform immediately the radical operation for the cure of cancer of the organ involved

22 To these recommendations may be added the following The routine pathological examination of all tumor tissues removed by operation, should be made compulsory To this end competent laboratories for the free diagnosis of pathological material should be maintained as a function of the State

# A TECHNIC FOR THE RADICAL CAUTERY OPERATION IN BREAST CANCER \*

BY JAMES FULTON PERCY, M D.

OF GALESBURG, ILLINOIS

FOLLOWING the progressive and improving work of Halsted, of Baltimore, Willy Meyer, of New York, and Kocher, of Berne, Switzerland, the results in the operative treatment of cancer of the breast made a distinct and gratifying advance. But little has been added to the technic of their operative work in this condition except in the way of improved cosmetic appearance of the post-operative scar and ease of operating by the incisions of Jabez N Jackson, J Collins Warren and Francis T Stewart

We are probably warranted in believing that in the hands of trained operators 50 per cent of the women who submit to the modern radical breast operation will live over the five-year period, without a recurrence of their carcinoma, provided always that the patient is at all in the operable class. In the remaining 50 per cent the greater number will have recurrences within the first year of the radical removal of the breast. The writer has seen a rather large number of these recurrences in the last three years. The location of the new invasion has been about equally divided between the site of the operation, including the skin, and the supraclavicular region. The latter space, in the cases seen, had not been invaded by the surgeon in his previous operative work. In recent years I have seen no operated cases where metastasis had developed either in the abdomen, thorax, or in the extremities.

A recent post-operative recurrence in breast carcinoma, which came under my observation, was Mrs M, aged thirty-four. She was born in Greece, the mother of three children; two miscarriages. When she presented herself for examination, because of a recurrence following removal of a left mammary carcinoma, she was three and a half months pregnant. The history of this breast is interesting from the fact that when twelve years of age she had an abscess which was incised by her physician. There remained a small lump in the scar which never disappeared. One and a half years ago this lump began to enlarge and at times was painful. Last June (1916) it had attained the size of a hen's egg, and was removed by a surgeon in a distant city, by the usual radical operation, including the extirpation of both pectoral muscles. She remained with no evidence of a recurrence for three months, when she began to fail physically,

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\* Read before The Western Surgical Association, December 15, 1916

became very anæmic, and lost 35 pounds in weight. Her hæmoglobin at this time was 50 per cent (Dare). One month after her operation she noticed a lump in the operative scar, size of an olive. There were also movable masses in the outer quadrant of the right breast, size of a hen's egg, that she had noticed for four years (Fig 1). The axillary glands on this side were also involved, many of the size of marbles being present. The right side had not been operated, why I do not know. The supraclavicular glands on this side were not palpable. The patient was bedridden and a physical wreck. Her left arm was enlarged about one-third. Metastasis was marked both on the operated and unoperated side, extending along the subclavian and axillary vessels. On the operated side points of recurrence, both in and below the skin, were very numerous. These were especially noticeable in the scar of the former operation and especially in the auxiliary incisions, which had been made in order to relieve the tension in the stretched flap. There were also recurrences in practically every suture scar. The new growths along the axillary vessels were extensive, fixed, and extended nearly one-third the way down the arm. The supraclavicular glands were not palpable on this side. The skin in the axilla was adherent to the underlying structures and on manipulation gave the examining finger the impression of a bony growth surrounding the axillary vessels, at least three inches long and two inches wide. All the tissues in this region, including the skin, were firmly fixed and immovable (Fig 2).

The patient complained of no pain in the thorax, no cough, and there was no special dyspnoea on exertion. The X-ray disclosed no metastasis in the lung tissue. This woman had a pale, pasty look, her eyes were sunken, the leg muscles were greatly atrophied, and with it all she was in the trough of despair. She had recently visited a number of clinics and from them all had received the usual advice to go home, take morphine, and die.

From any point of view, to say nothing of its surgical aspects, this case was a most unpromising one. My purpose in reporting it, however, is not to describe the technical difficulties incident to the treatment of a case of this character by the cautery, but, rather, to emphasize, first of all, the ease with which the cold steel knife, in some cases at least, disseminates by auto-infection the cancer-cell, or germ, and, second, to describe a technic by the use of the cautery knife, which will reduce the danger of the dissemination of this unknown infection to a minimum. A careful view of Fig 2 easily demonstrates the area of the skin surface and of the axilla involved in the recurrence following so soon after this patient's operation.

Modern surgery has always recognized the necessity of preventing bacterial infection of the operative field. In an indefinite, or, rather, perhaps, in a haphazard way, this necessity has been recognized also in the operative surgery of cancer. Autotransplantation infection in cancer



FIG 1 —Movable masses in right breast

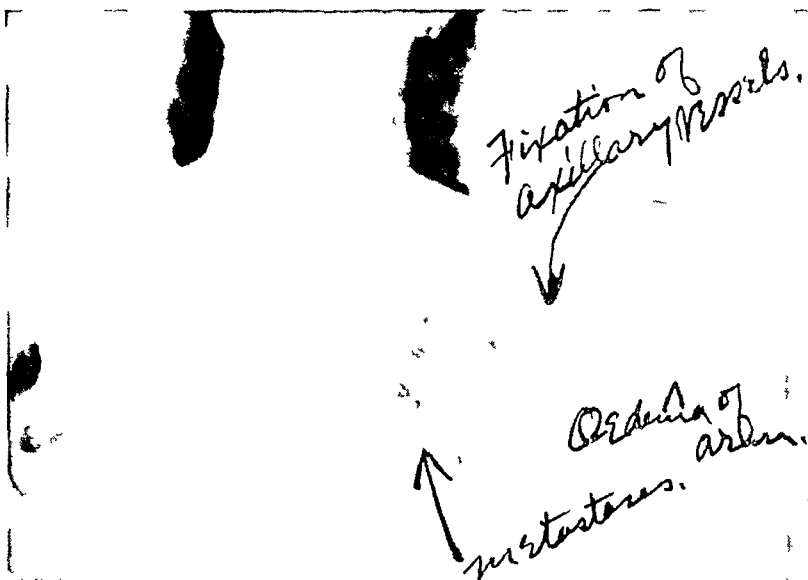


FIG 2

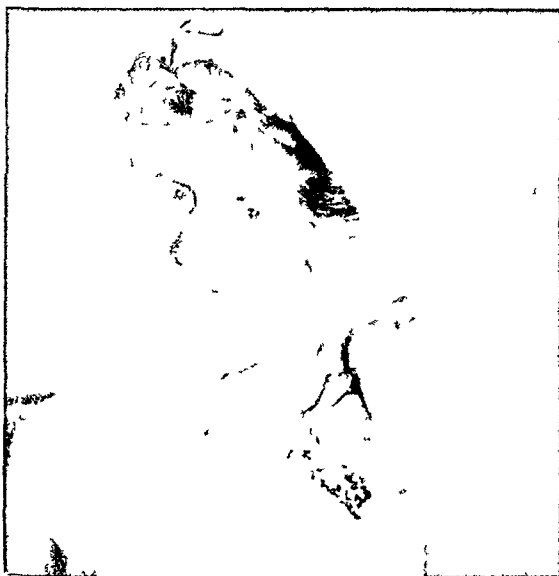


FIG 3 —Note enlargement of arm and forearm, six weeks after cautery removal of the breast The wound is granulating and healthy



FIG 4 —Showing condition of patient, one year after operation



FIG 5 —The application of small pieces of adhesive plaster, after the method of Beck. This technic limits secretion from the wound, encourages cicatrization and adds to the comfort of the patient

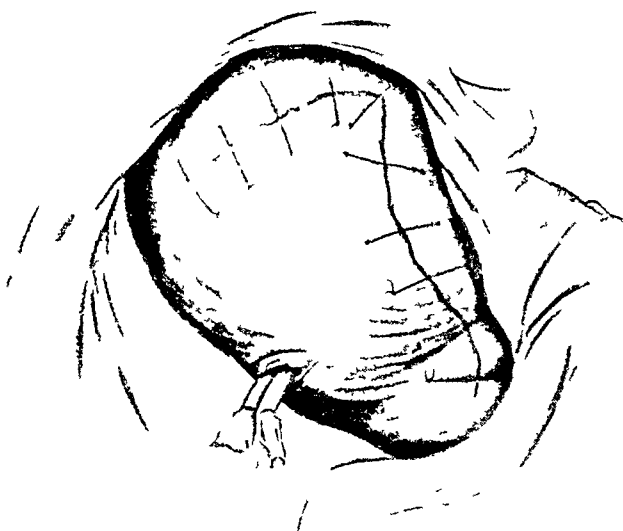


FIG 6 —Note the wide grasp of the sutures. This insures a better repair of the cautery incision



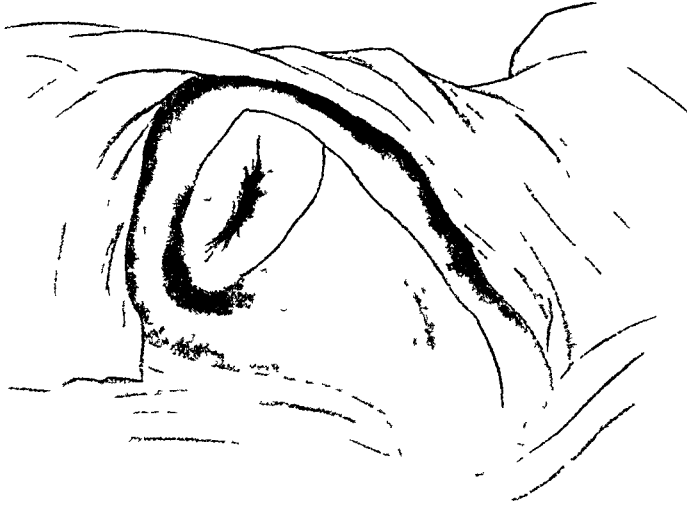


FIG 7 —The outline of the clay-pipe incision to be made with the cautery on the iodine-covered skin

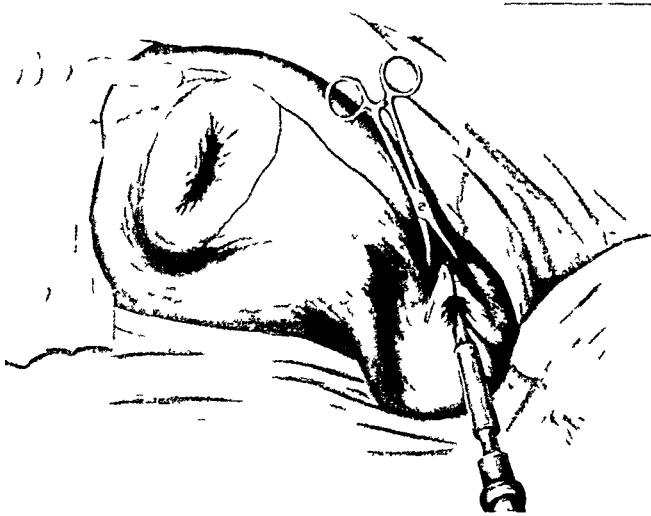


FIG 8 —The upper cautery shows the incorrect method of getting under the skin. The dimpling incident to pushing the cautery under the skin permits of too much destruction of the skin surface. The lower method, whereby the skin surface is lifted up by a wide-jawed tenaculum forceps, and the cautery pushed under the skin, in the line previously mapped out on the surface, gives a better result in the final healing because of the irradiated heat.



FIG 9 —Cautery dissection of the flaps



FIG 10 —Opening up of the axilla by severing the tendons of the pectoralis major and minor with the fingers placed back of the tendons. The cautery is shown too near the cut edge of the skin

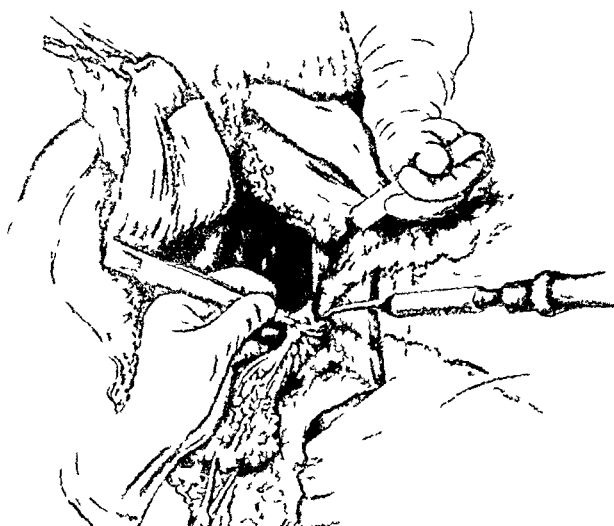


FIG 11 —It is better to hold the gland-bearing fascia with the fingers in place of the dissecting forceps and keep them nearer the cautery knife than is shown in the illustration. This will enable the operator to gauge the degree of heat that is being spilled over the vessels and tissues.



FIG 12 —Removal of the gland-bearing fascia with the cautery. The fascia should be held with the fingers, as stated under Fig 11, and close to the cautery. This is especially true when cleaning off the axillary vessels.



FIG 13 —The condition of the patient and the character of the wound fifteen days after the operation are well shown

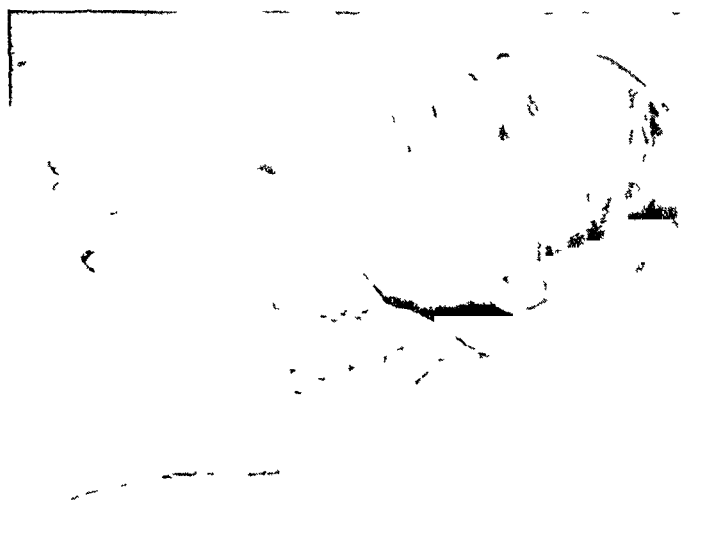


FIG 14 —Appearance of the wound forty-nine days after the cautery dissection. The axillary vessels are well covered in by healthy granulations, and this is true of the whole wound area. This patient died suddenly the day following the date of this photograph. There was extensive metastasis into the left hip and throughout the whole bony structure of the pelvis. The operated breast area was free from cancer.



is an insistent fact when the ordinary methods for its removal are used, and the only means at our command for its prevention have been mainly by the advocacy of incisions made wide of the disease, this, always, with the hope not only of getting all of it, but, more to the point, of preventing the knife of the surgeon from coming in contact with a small focus of the disease at an unusually outlying point. The trouble is that the disseminating and stimulating effects of the cold, sharp edge of the surgeon's scalpel have not been recognized acutely enough. This danger, I repeat, has always been known when infective bacteria was the problem in the operative field. But infective bacteria, when managed according to present day surgical principles, are a simple enigma in comparison to the cancer-cell. Surgery, so far, has not been able to evolve any principle, or principles, that either modifies or prevents the slow but certain progressive development in the tissues of the cancer-cell, except the one just mentioned, of wide excision. Bacterial infections are usually surface infections. They can be washed and poisoned away. The infections of cancer are not surface infections. They cannot be washed or antisepticized, because they are in the tissues and skin, not outside of them. Modern surgery has not yet recognized this fundamental difference in a practical way. Present day surgery still exposes and spreads cancer along newly-made tissue surfaces, and stimulates it into new virulence with the cold steel knife, and then carefully sews in and covers up with flaps the infection of cancer where it can spring again into new life, uncontrolled and unhindered. In this way we ignore every known surgical principle for the prevention of cancer infection. When the flaps are sewed together, we have a hope that nothing is left in them, or in the wound, and we keep on hoping for five years that the infection will not show up.

The prevention of the auto-dissemination of cancer during its removal is the greatest problem in the operative treatment of the disease to-day. This is especially true in the so-called inoperable types of advanced carcinoma, regardless of its location. In offering the cautery knife as a valuable substitute for the cold steel knife, I do so because it disseminates heat and heat kills the infecting principle, whatever it may be, of cancer. The cautery will destroy the infecting agent, not only with every step of the dissection at the immediate point of contact, but a considerable distance beyond. This is true of the cut edges of the tissues, of the flaps, and of the deeper structures, as well. They are left not only sterile, but immune to the further development of the cancer growth. It should also be emphasized that all tissues involved in cancer should be manipulated in the most gentle way possible, both before and during operative procedures. I am convinced that to ignore this means a greatly increased possibility of disseminating the disease into new regions.

It will probably be of interest and value to state here that I have seen no untoward results from the use of the heat, even when large areas of the thorax, axilla and the neck were denuded of their coverings by the heat technic that I shall outline below.

The only possible exception to this is Mrs F M , aged forty-two, who was suffering from a very extensive infected and ulcerating right mammary cancer which she recognized first some four years previously. The right arm was also greatly enlarged, painful, and useless. Her chief complaint, however, was from what she called her "rheumatism". This seemed to consist of a generalized myositis. The pain, together with the stench from the ulcerating breast, was what finally drove her to seek surgical relief. The involvement of the axilla, with the extension of the malignancy from the breast, was so great that I decided to do an interscapulothoracic amputation at the shoulder-joint, with the cautery, at the same time that the breast was removed. The operation was performed December 22, 1914, and required thirty minutes. No clamp was used at any time, except on the subclavian artery and vein. This woman was a bad risk from the beginning, but she was out of bed and in a wheel chair on the third day, and was having a normal convalescence until the eleventh day, when she developed a chill, rusty sputum, and a pneumonia in the left lung (the one opposite the operative field) and died on the third day, fourteen days following her operation. This result may have been connected in some way with the extensive use of the cautery, but I have never been convinced that it was. This is my only operative fatality.

My only accident from the use of the cautery in the axilla occurred while operating on Mrs J P H , aged fifty-eight, who was first examined March 25, 1916. Three years before she had noticed a small lump in the outer edge of the left breast. She had had no previous treatment and consulted the surgeon only because the breast was ulcerating and painful. At the time of the examination, the breast was fixed to the thorax, and showed both glistening red and blue areas, as well as the ulcer, which was about the size of a silver dollar. The X-ray disclosed no involvement of the lung or ribs. Amputation of the breast and dissection of the axilla with the cautery was done March 26, 1916. In dissecting the axilla the cautery knife was carelessly allowed to touch the axillary vein for too long a time, and instantly the whole of the exposed vein became thrombosed, as is shown in Fig 3. The arm increased in size, at least one-third, before she left the hospital. In physical appearance it reminded one of the familiar lymphangitis that occasionally follows breast amputations by the ordinary technic. Fig 4 shows the present condition of this patient, and especially of her arm. The enlargement practically disappeared in six months. The function of the arm, at the present writing, is in no way interfered with, except by the scar, which resulted from the extensive dissection required at the primary operation. The return of the circulation in the arm can probably be explained by the ease with which the collateral circulation is re-established through the cephalic vein over the top of the shoulder.<sup>1</sup>

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<sup>1</sup> This patient recently presented herself because of severe pain in the left humerus. An X-ray showed a metastatic focus, involving the whole diameter of the humerus at its middle portion, about one and one-half inches in length. The arm was then amputated with the cautery at the shoulder. At the present writing she is in good condition.

## CAUTERY OPERATION IN BREAST CANCER

The actual technic of the use of the cautery is essentially not unlike the ordinary method with the steel knife. When one becomes familiar with this, the danger is no greater, as far as the axillary dissection is concerned, than with the scalpel. More than this, there is a great satisfaction in knowing that the hot knife is not disseminating carcinoma in its way through the tissues, and, besides, the heat is having an influence for good considerably beyond the area involved in the immediate contact with the cautery knife. In other words, the heat can be made to go safely where the cautery or cold steel knife cannot go. The explanation is that the circulating blood remains at a constant temperature, indeed, acts as a water-cooled speculum, thus protecting the walls of the larger blood-vessels, but not the carcinoma which may be in the tissues about them.

Frequently, intact carcinoma cells can be found about a large blood-vessel. In such cases, it is probable that the circulating blood prevented the heat from attaining a temperature sufficiently high to destroy the attached carcinoma cells. The blood-vessel has merely acted as a water-cooled speculum, protecting the carcinoma cells from the destructive action of the heat. No artery clamps should be used to arrest hemorrhage in the small vessels, the application of the heat is sufficient. This not only arrests the hemorrhage, but it does more by destroying the possibly present nesting carcinoma cells. It is for this reason also that in these advanced cases, flaps to cover the wound should not be especially striven for. If small points of carcinoma develop in the uncovered wound, they can be treated at any subsequent dressing by applying a little cocaine and touching them with the cautery point until destroyed.

Again, scar tissue of this type seems more likely to remain free from a new growth of malignancy than is the normal tissue. This surface treatment of cancer by heat is thus made much more effective than can ever be true of cavity carcinoma. Carcinoma developing under the made flaps, following a breast amputation, puts it at once in the same class with the insidious type of cavity carcinoma, *i e*, the small points of recurrence cannot be recognized early enough for the most effective treatment when covered by the flaps.

Wiping out the axilla with gauze is, I am convinced, a fruitful source of recurrences in removal of the carcinomatous breast. This method of dissection also violates every surgical rule for the prevention and dissemination of infection and should be included with the cold steel knife in its dangerous proclivity to stimulate anew the growth of cancer.

Freedom from hemorrhage is one of the very important advantages of using the cautery knife. It not only shortens the time that would otherwise be taken in clamping and tying bleeding vessels, but, as stated above, it lessens the possibility of a recurrence about the blood-vessels. More than this, the work of Gaylord seems to show that the saving of blood



is an important factor in lessening the destruction of the natural immunity that most of these cases undoubtedly possess

Necrosis of the exposed ribs frequently follows the application of the heat. But I have never seen this necrosis go below the edges of the intercostal muscles, and I have yet to see either a pleurisy or a pneumonia develop, except in the one case mentioned above. Indeed, the majority of these patients are remarkably free from pain, or any other form of uncomfortable post-operative experiences. Cooked flesh tells no tales.

The post-operative treatment is dependent upon whether flaps are used, or not. In the very advanced cases in which no attempt is made to obtain flaps, the surface is immediately covered with adhesive plaster, after the method of Beck (Fig 5). Where flaps are used to cover the wound, all or in part, they can be undermined or dissected up by the cautery in exactly the same way that is done where the steel knife is used. Sloughing of the flaps is rare, except occasionally at the points. In a few cases (two) where the tension on these flaps has been more than moderate, an active inflammatory condition developed that almost suggested an erysipelas. Both of these were in very fat women. Relieving the tension by removing some of the sutures, and the application of a solution of boracic acid and alcohol improved the condition, usually within twenty-four hours. It is very probable that some of the newer antiseptic solutions that have come into use as a result of the European War would find a useful place in cleaning up these uncovered cautery breast wounds.<sup>2</sup> Where the flaps are employed, usually one drainage opening is sufficient. In closing the wound, it is important to put the sutures about three-fourths of an inch back in sound tissue and away from the coagulated edges of the wound (Fig 6). This insures the sutures holding. If one wants flaps, they can be obtained nearer the gross mass of cancer than would be wise with the knife, for the reason that the heat almost insures against the further development of the cancer-cell in the flaps. The temperature of the knife should not be so great as to encourage very rapid cutting. To do this prevents the abnormal tissue cells from coming in contact with or being destructively influenced by the coagulating degrees of temperature which experience has shown are most useful for this purpose.

The four factors most useful in the heat technic are. First, mark out on the iodine-covered skin, with the cautery knife, the limits of the incision to be made (Fig 7). Second, do not cut with the cautery knife from above downward into the skin in following this line, but from within outward. This can best be done by lifting the skin up with a tenaculum forceps (Fig 8) and pushing the hot knife into and under the skin, and cutting from within outward. To do otherwise causes too great a

<sup>2</sup> Since writing the above, I have found that one of the most valuable of these solutions is "eusol." It consists of twelve and one-half Gm. each of acid boracic and chlorinated lime in one litre of water. Shake. Let it stand for three hours and filter.

## CAUTERY OPERATION IN BREAST CANCER

sloughing of the edges of the skin. The drainage hole should also be made by pushing the cautery knife through the skin from within outward. Third, and very important, in dissecting about the axillary vessels and brachial plexus, hold the tissues that are to be removed with the fingers of the free hand encased in a medium-weight rubber glove, and keep the fingers close to the cautery knife (Fig 9). This is the most practical way of gauging the degree of temperature that the tissues and blood-vessels will stand, without being injured. If the axillary vein or artery is not actually touched for too long a time with the hot knife, they will remain uninjured. Fourth, apply the heat until all the tissues that were fixed by the disease are freely movable. To do otherwise simply means that heat dissemination in the most effective way has not been obtained.

The two most important factors in the after-treatment are. First, to keep the wound clean, which can easily be done by alternating the use of adhesive-plaster covering with the "eusol" solution, and exposure to the direct rays of the sun, and, second, to keep the arm in a vertical position alongside of the head. This prevents both œdema and cicatricial contraction.

# REGIONAL ANÆSTHESIA IN EXTRAPLEURAL THORACOPLASTY AND SOME INTRATHORACIC OPERATIONS\*

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WHOEVER has followed the trend of events as regards the production of analgesia must have been impressed by the fact that abroad the tendency of surgeons has been to become emancipated from general anæsthesia in their daily work, as much as possible, whereas the majority of American surgeons have faithfully worked for years to improve and safeguard general anæsthesia

Only a few surgeons here have employed regional anæsthesia on a larger scale within the last years. That it must be an advantage to the patient not to have taken an anæsthetic needs no discussion. Whenever the main nerve-trunks that feed the operative field can be reached with safety, regional anæsthesia is feasible. All that is necessary on the part of the surgeon is practical experience and some patience as well as the time to wait until the fluid that produces the analgesia has taken effect.

It is important to remember that it is not a matter of necessity to have the needle strike the nerve-trunk itself, although this is naturally most effective and, usually, harmless, but that the "perineural infiltration," that is to say, the injection of the analgesic fluid into the tissues surrounding the nerve, suffices to block it. We know that sixty to seventy per cent of all operations can now-a-days be carried out under regional and local anæsthesia. On my division at the German Hospital it has been practised for many years.

The surgeon's principal reason for not using this splendid method more often is lack of time. One *has to wait* until the injected fluid has taken effect, and it takes ten to twenty minutes. It is absolutely necessary to wait this long in major operations in which the work involves a larger area. In the more localized operations, such as, for instance, thyroidectomy, suprapubic cystotomy, etc., a few minutes are sufficient to produce the desired effect. If the surgeon has to, or wants to, carry out the injection of the analgesic fluid himself, he will do well to first attend to the infiltration, after disinfection of that portion of the skin where the injection has to be made, and then get himself and the patient ready for the operation. In our general hospitals it would seem to be in the interest of the work to have one man, *e g*, one of the assistant adjuncts, become expert in regional anæsthesia and then have him permanently assist in all these operations. He should "start the next case," same as we now are wont to have the anæsthetist start the next general anæsthesia.

There certainly is no region of the body more favorable for the appli-

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\* Read before the American Surgical Association, June 1, 1917

cation of regional anæsthesia than the thoracic portion and particularly the *chest-wall*, for there are the twelve pairs of thoracic nerves which feed it and can be reached with comparative ease and safety. But also some intrathoracic operations can be well done without general anæsthesia. Only the virgin-pleura, when divided on opening the pleural cavity, usually answers with such tremendous reflexes that a few whiffs of an anæsthetic become necessary at this time. Later on a drop of an anæsthetic, administered now and then, suffices to enable the surgeon to do his work. An inflamed and thickened pleura stands handling very well under regional anæsthesia.

An anæsthetist certainly must be at the helm. Many patients are extremely nervous and irritable. Some will simply refuse the operation unless they "can be put to sleep." In such cases we have conducted a sham inhalation anæsthesia with a solution of one-half alcohol and one-half water, or exceptionally, have had a few drops of chloroform or anæsthol administered, not enough to cause the patient to completely lose consciousness.

Regarding my own experience with regional anæsthesia in thoracic surgery I have used it in cases of empyema and of lung abscess, in ligation of branches of the pulmonary artery, and particularly in extrapleural thoracoplasty. The latter term has been given to the operation of multiple rib resection, done in cases demanding compression of the affected side of the chest. The troubles that come into consideration in this respect are chronic suppurative inflammation of one or more lobes of the lung, of tuberculous or non-tuberculous character. As to the latter class, patients suffering from bronchiectasis have been subjected to the operation, mainly after branches of the pulmonary artery had been tied at a previous sitting for the purpose of producing shrinkage and carnification of the lung parenchyma by connective-tissue proliferation, after the lung had been thus deprived of its physiologic function (Sauerbruch-Bruns). In some instances I have also tried the effect of the operation without this preliminary procedure. In tuberculous patients the indication for extrapleural thoracoplasty has been established in the presence of cavity formation within the upper lobe, if compression by means of air- or nitrogen-insufflation into the pleural cavity had become impossible on account of adhesions that had formed between pulmonary and costal pleura, and hygienic medical régime had ceased to be of benefit.

As far as extrapleural thoracoplasty in bronchiectatics is concerned—to which class of patients my own experience with the operation so far has been confined—I hardly believe that it will be often resorted to now-a-days. The evolution of the surgery of this chapter certainly points in this direction. Experience so far gathered has shown that, even with the preliminary ligation of the feeding branch of the pulmonary artery, the operation will but improve the disease—rarely cure it. Earlier cases of bronchiectasis in which all the lobes of one lung are affected seem to yield to methodical irrigation of the bronchial system of the affected lung with antiseptic fluids. When confined to one lobe alone pneumotomy with prolonged drainage will sometimes bring the desired result, a persistent bronchial fistula can be

closed by a secondary operation later. In more advanced cases the excision of the affected lobe will have to be done in one or more stages. A number of surgeons, particularly in this country, are now hard at work trying to find ways and means of lessening the dangers of this operation. Hence, typical extrapleural thoracoplasty will at present come into consideration principally in cases of advanced pulmonary tuberculosis that are beyond help from the milder procedures and would be left to die if the bloody operation were not resorted to.

For the sake of completeness I will mention that we have three methods of extrapleural thoracoplasty, that of Friedrich, Sauerbruch and Wilms.

Friedrich, at the suggestion of Brauer—both then holding positions at the University of Marburg—raised the scapula with the help of the typical Schede incision (Fig 1), with the patient under a *very* superficial chloroform anæsthesia. The tenth rib up to the second, or also including the first, were then resected subperiostally in their entire length. On account of its magnitude and frequent deleterious effect upon the heart's action in these weak and reduced patients, this method was soon abandoned. Sauerbruch then proposed the stage-operation. He insists that it is of importance in weak patients with reduced power of expectoration, first to compress the lower lobe with the help of thoracoplasty, in order to avoid aspiration-pneumonia of this lobe from the cavity formation within the upper lobe. For this purpose he resects the fifth to the tenth, or the sixth to the tenth ribs inclusive, at the first stage. At the second stage, following in about two weeks, the upper four or five ribs with or without a portion of the clavicle are cut out. Only if the patient seems to have considerable power of resistance the greater part of the first to the tenth rib may be removed at once. He uses the so-called posterior hook incision, a cut that represents the posterior half of the Schede incision (Figs 2 and 3). In all his operations he employs regional and local novocaine anæsthesia.

Wilms does not attach any particular importance to the primary compression of the lower lobe, but attacks at once the upper ribs. He also prefers to operate in stages and favors the so-called "columnar resection," posteriorly as well as anteriorly, leaving the middle portion of the ribs in place (Fig 4, B, C, D). In advanced cases of upper lobe cavity-formation the sternal portion of the clavicle is included in the resection in order to increase the compression (Fig 4, A). Wilms also works with regional and local anæsthesia.

It stands to reason that it must be of great advantage to these patients if the operation can be carried out under regional anæsthesia. They thus remain able to expectorate at will, and have their mouths free and unincumbered. The ever-threatening aspiration pneumonia is thereby reduced to a minimum.

*Sensory Innervation of the Thoracic Wall*—The sensation of the thoracic wall on either side is controlled by the twelve thoracic nerves. The first of these leave the intervertebral foramen between the first and second dorsal vertebrae, the twelfth between the twelfth dorsal and the first lumbar vertebrae.

Immediately after they have made their exit from the spinal column, they divide into a stronger anterior and a weaker posterior branch (Fig 5) Both are mixed nerves, viz, they carry motor and sensory bundles The anterior branch communicates with the sympathetic ganglion (Fig 6), enters into anastomosis with its neighbors (ansæ or plexus), and innervates the broad muscles of the back The posterior branch also anastomoses with its neighbors and innervates the long dorsal muscles and the skin of the back

The anterior branches run in the intercostal space as "intercostal nerves" Each of these gives off to the chest wall a *nervus cutaneus lateralis*, which subdivide again into anterior and posterior branches ("*nervi cutanei laterales pectoris anteriores et posteriores*") Of the *upper* six thoracic nerves the anterior branches of these lateral nerves innervate the skin of the mammary gland and the gland itself, the posterior branches provide sensation to the skin of the back Of the *inferior* six lateral cutaneous nerves the anterior branches run to the skin of the anterior abdominal wall, the posterior branches to the skin of the back ("*nervi cutanei laterales abdominis anteriores et posteriores*") The intercostal nerves, after having given off the lateral cutaneous branches of the chest, feed the intercostal muscles At the border of the sternum they perforate the major pectoral muscle and terminate as "*nervi cutanei anteriores*" in the skin of the anterior aspect of the breast

*Instruments*—A syringe to which the needle can be firmly attached by a bayonet-arrangement (Fig 7, *a*), or by a special design (bit-clutch) (Fig 7, *b*), is preferable to the well-known record syringe The latter lacks the firm union with the needle, besides, it works hard and affords no support to the surgeon's second and middle fingers during injection of the fluid The needle must be fine and of sufficient length (6 inches)

*Solution*—A one-half per cent solution of novocaine with suprarenin is usually efficient A strength exceeding one per cent is inadvisable One hundred to two hundred cubic centimetres (about 3 to 7 ounces) may be required If sufficient time is allowed to elapse between injection and start of operation (about 15 to 20 minutes), the analgesia will in most instances be satisfactory If the patient reacts, a very few drops of an anæsthetic will quiet him The hypodermic injection of morphine, or pantopon (one-half gram), one hour before the beginning of the operation, is of great assistance

Whether the additional hypodermic administration of scopolamine is advisable I am not prepared to state as yet We have seen most satisfactory results from this combination in all kinds of major operations Perhaps it will prove equally beneficial in thoracic cases The reason that I have not tried it has been that I feared it might not leave the patient sufficient self-control to cough and expectorate If it were determined that this fear was unfounded, a hypodermic of scopolamine might be added with advantage also in these cases

*Technic*—There are two good methods at our disposal One was worked

out at the Zurich Clinic (Sauerbruch), and published by the late Schumacher, the other is practised at the Kiel Clinic (Anschuetz), and was published by Kappis. Both appeared in print at the same time (*Centralbl f Chir*, 1912, No 8, pp 249 and 252)

In the first method the nerve is reached at the angle of the rib (Fig 8, *a*), in the second it is reached proximally to this location, viz anteriorly and inwardly from the angle (Fig 8, *b*). Here the thoracic nerve with all its branches can be infiltrated. The technic of the Kiel procedure is more difficult. In carrying it out the needle must strike the rib at or near its articulation with the transverse process of the vertebra. The location of this articulation is usually found  $3\frac{1}{2}$  cm ( $1\frac{3}{8}$  inches) to the left or right of the median line. The difficulty is, that, because of the rib running forward and inward at this place, one cannot palpate its proximal extremity through the bellies of the thick muscles near the spine. However, even in stout individuals one of the lower ribs usually can be made out somewhere in the back. If the lower border of this rib is projected in the direction of the same medially, the point of entrance for the needle is found at the spot where this projection line crosses a perpendicular line drawn parallel to and  $3\frac{1}{2}$  cm to one side of the median line, viz the spinous processes (Fig 9). The next lower border of a rib above or below is about 3 cm ( $1\frac{3}{16}$  inches) distant. In order to facilitate the work of finding the respective point of entrance at the subsequent ribs I had a flexible (sterilizable) tape-like metal-strip made, with a 3 cm scale on one side and a  $2\frac{1}{2}$  cm scale on the other (Fig 9, *A*). This has been found a useful addition to our instrumentarium.

After the respective number of the palpable lower rib in the back has been ascertained all one has to do is to count the markings on the scale upward and find the top rib that is wanted. From here the operator will then proceed downward with the infiltration from rib to rib, as many as have been slated for resection. Or, if the lower rib, the number of which has been made out, lies within the operating field, one can commence infiltrating the thoracic nerve of this rib and then advance upward, step by step, at  $2\frac{1}{2}$  to 3 cm distance. It seems best to commence with the lower rib and work from below upward.

Of course, this distance of 3 or  $2\frac{1}{2}$  cm is not found correct in every instance. It varies with the size of the patient. Still, as an average, the marked distances have been a welcome aid. In order to be on the safe side, the thoracic nerve of the two ribs beyond the field of thoracoplasty, above as well as below, are included in the blocking.

For both methods the patient lies on the operating table, best on his stomach, with his head close to the upper end, and both arms hanging down perpendicularly (Fig 10). A sand-bag or other round pillow supports the abdomen to overcome the lordosis. After proper disinfection and iodinization of the entire back, regional anæsthesia is started.

If the Zurich procedure is chosen, the line of the paravertebral skin incision (Fig 2) is anæsthetized first and *within this* line the needle is painlessly introduced. The latter is advanced from below and inward in an



FIG 1—Schede's incision, raising a skin muscle flap including scapula, exposing the entire length of the first to tenth ribs

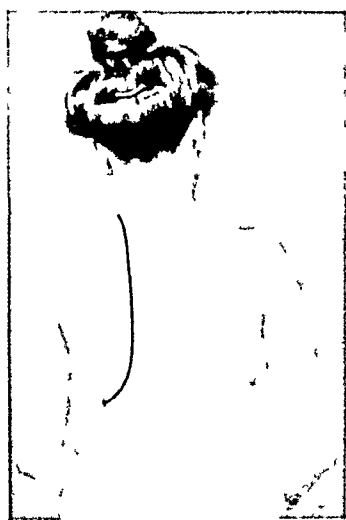
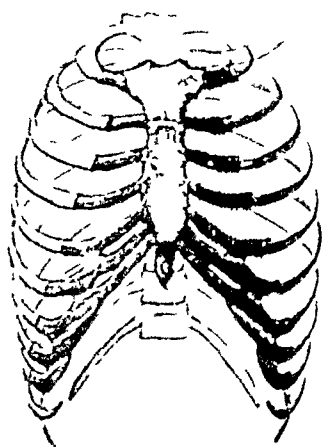


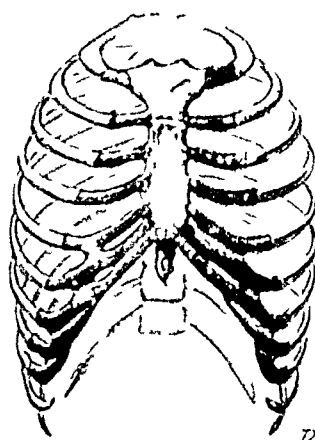
FIG 2—Sauerbruch's 'hook' incision, representing the posterior half of Schede's incision



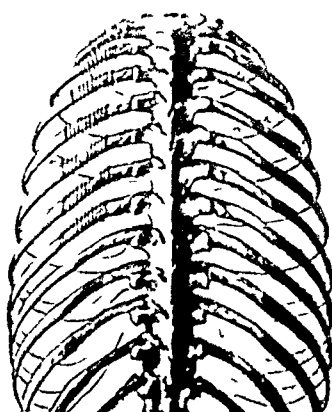
FIG 3—Exposure of the posterior two thirds of the ribs by means of the 'hook incision,' the inner border of the scapula being pulled outwardly



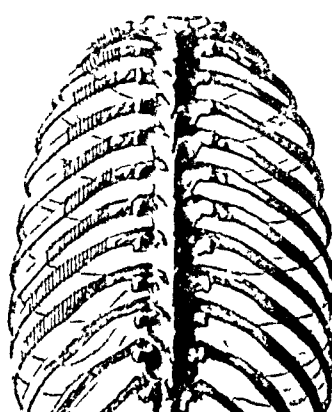
A



B



C



D

FIG 4—Illustrating Wilm's "columnar resection" of the ribs (From *Muench med Wochenschr*, 1913, pp 450 and 451) A, resection of the cartilages plus adjacent portions of the upper five ribs, also of the sternal extremity of the clavicle, in order to increase the contemplated compression of the diseased lung B, same as in A, without the additional operation on the clavicle C, resection of the upper seven ribs in the region of their angle D, same as in C, operation involving the nine upper ribs Note the increasing length of the resected portion of seventh to ninth ribs



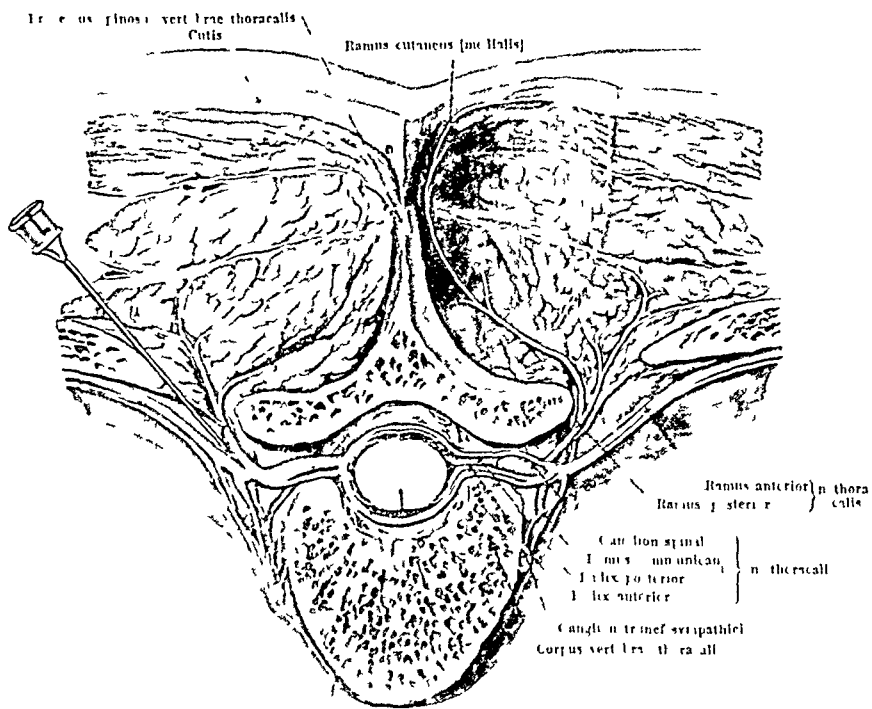


FIG 5 —Transverse cut through dorsal spine with muscles of back. The needle has been added by author in order to point to the efficiency of this regional anæsthesia if the method is carried out correctly (From Spalteholz Handatlas der Anatomie des Menschen vol III Fig 690)

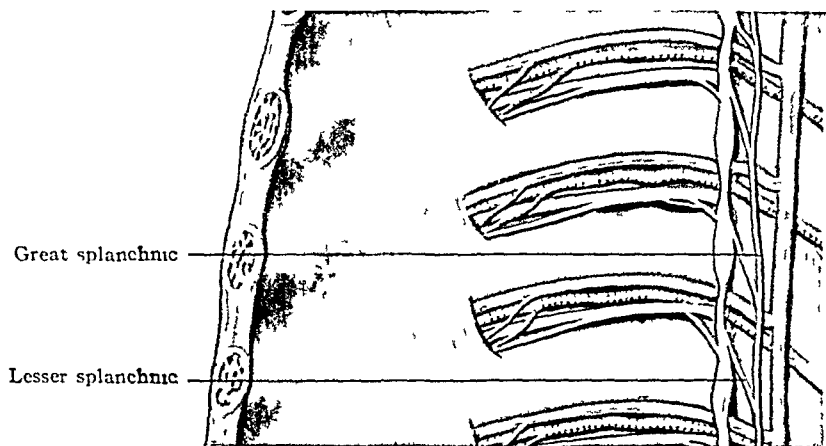


FIG 6 —Showing anastomosis between the intercostal nerves and the thoracic portion of the sympathetic and its ganglia (From Heitzmann Handatlas)

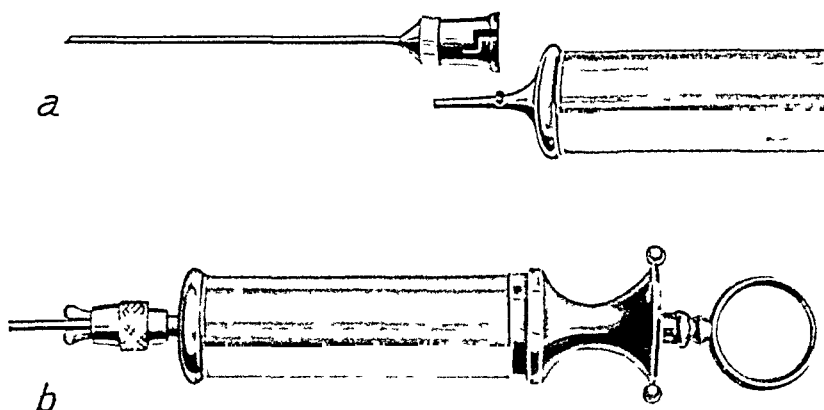


FIG 7—*a* record syringe with a metal knob at nozzle. The needle shows the notch of bayonet attachment, making both parts a firm unit. *b* Heynemann's all-metal syringe for local and regional anesthesia holding needle with bit clutch arrangement.

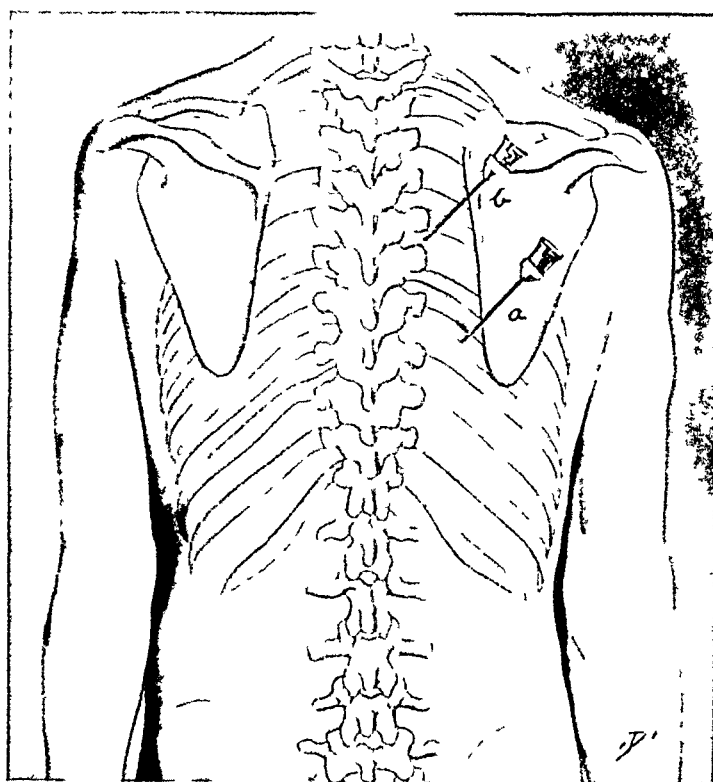


FIG 8—Diagrammatic, illustrating the location where the needle is introduced in Schumacher's, *a*, and Kappis's, *b*, methods. In practice the needle at *a* has to point upward and outward and run close to the rib.

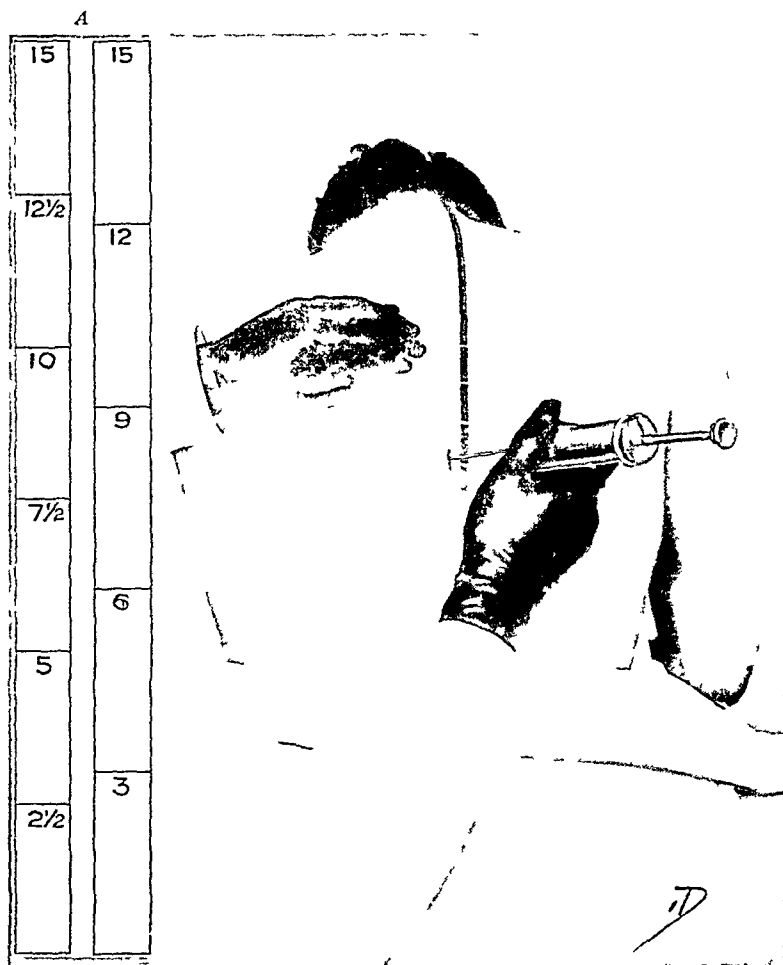


FIG 9 —Illustrates Kappis's method of regional anæsthesia in thoracic operations with the patient in the sitting posture A, the sterilizable metal tape divided by  $2\frac{1}{2}$  and 3 cm



FIG 10 —The same as Fig 9 with the patient in the abdominal posture lying horizontally on the operating table (In the picture the table has been tilted in order to allow the artist to photograph the entrance of the needle in the back )

upward and outward direction toward the angle of the rib above. When the grating sensation is felt one to two c c of the fluid are deposited. The needle tip then finds the lower border of the rib, where 5 to 8 c c are injected. About 10 c c in all are used. The same procedure is then repeated with each successive rib.

If the Kiel method is used one of the lower ribs is carefully palpated and now the first point of entrance located as just described. The point of puncture is first frozen with the ethyl-chloride spray. The operator's nail marks the place for freezing the skin. As soon as the spot has turned white the needle is pushed through the skin and conducted slowly down in a straight sagittal line until it touches the bone. In the average case the distance from the skin to the rib measures about 4 to 5 cm ( $1\frac{1}{2}$  to 2 inches). The scratch of the needle's tip on the bone must be clearly felt. Now the operator searches with the needle the lower border of the bone and then pushes it gently forward in a slightly inward direction toward the spine for about  $1\frac{1}{2}$  cm ( $\frac{3}{4}$ -inch) (Figs 5, 9 and 10). At various depths the fluid, 8 to 10 c c in all, is injected. In this process the nerves most likely often are hit and their substance directly imbibes the novocaine solution. But this leaves no deleterious effect. Step by step, with the same technic and continued care, the respective ribs are treated. One must remember that when attending to the upper ribs, the increasing thickness of overlying soft tissues makes the needle sometimes pass to a depth of nearly 5 to 6 cm ( $2\frac{1}{2}$  inches), before it strikes the bone. When the last rib above—according to previous determination—has been attended to, it is necessary to wait for 15 to 20 minutes before starting to make the incision—the important point which I would like to particularly emphasize once more. The mistake we all are prone to make—thereby depriving ourselves and the patient from reaping the full benefit of the regional anæsthesia—is, that, owing to lack of time, we cut down these minutes.

Complications, such as puncturing blood-vessels or the lung, have not been observed. Neither method appears to be connected with danger to the patient. Kappis has seen that when the needle pricked the pleura, the patient suddenly began to cough. He withdrew the needle somewhat, giving it a different direction, and no harm resulted.

The strength of the solution should be  $\frac{1}{2}$  per cent. This was used at Zurich with satisfactory results. Kappis employed a 1 to  $1\frac{1}{2}$  per cent solution but states that he intends to reduce the strength. In one of my cases a most profound collapse occurred after liberal use of a one per cent novocaine solution, about 80 to 100 c c. The operation (thoracoplasty on a bronchiectatic) had to be postponed. Six days later the  $\frac{1}{2}$  per cent solution, applied in the same manner, gave a satisfactory result.

I have so far practised Kappis's method only, this for the reason that it appealed to me as anatomically particularly efficient. However, I shall not fail to try Schumacher's method as soon as an opportunity presents itself. The analgesia derived from the latter has been lauded by many

colleagues who had a chance of seeing it carried out. The amount deposited at each rib is about 10 c.c. in both methods, as stated above.

My cases of extrapleural thoracoplasty done under regional anaesthesia, seven in number, were all bronchiectatics. The operations were done at a time when I tried the effect of this procedure in advanced, non-tuberculous suppurative affections of the lung, in three of them branches of the pulmonary artery had been ligated at the first stage. I have been much pleased with the working of the anaesthesia, now and then a few whiffs of an anaesthetic were required, especially in reduced nervous individuals.

In one case, a thoracoplasty requiring resection of the first to the tenth rib, an ideal regional anaesthesia—without the addition of any inhalation—was obtained, the patient conversing during the entire operation, never once complaining of pain.

Extrapleural thoracoplasty for advanced pulmonary tuberculosis—the real field for this operation—I have not been able to carry out so far, owing to the impossibility of getting such patients admitted to the hospitals with which I am connected. All my efforts in this direction within the last five years were thwarted. However, I am glad to be able to add, that it is now planned at the German Hospital to have two rooms in the Thoracic Pavilion set aside for this class of patients.

The fact that more than 66 per cent. of these otherwise entirely hopeless cases have been greatly improved or cured at the hands of surgeons abroad by such compression from without, with the help of thoracoplasty, should serve us as a stimulus to find ways and means by which it may become possible to afford patients of this type the opportunity of benefiting by operative procedure, thus saving at least a number of them from certain death.

Regional anaesthesia has been successfully applied by me so far in only one patient with advanced pulmonary tuberculosis with cavity formation in the left upper lobe, on whom I performed Tuffier's operation. Here, after resection of a piece of the third rib in the anterior axillary line and division of the posterior lamella of the rib periosteum plus endothoracic fascia, the costal pleura was gently pushed off the chest wall, including the apex of the lung, and then a paraffin-plumb introduced.

The same method of regional anaesthesia has been many times carried out in single or multiple rib resection for empyema, in pneumotomy for lung abscess, exploratory thoracotomy for lung tumor and for ligation of a branch of the pulmonary artery. In one of the latter cases the patient, an intelligent young man, was conscious during the entire operation. Only at the time of opening his pleural cavity, which showed no signs of chronic inflammation, a small amount of an anaesthetic had to be administered.

There can be no doubt that regional anaesthesia represents a great asset in the successful performance of extrapleural thoracoplasty as well as in some intrathoracic operations.

# THE ADVANTAGE OF CHOLECYSTECTOMY IN THE AVOIDANCE OF ADHESIONS IN GALL-BLADDER SURGERY

BY A MURAT WILLIS, M.D.

OF RICHMOND, VA

I HAVE long been impressed with the much greater frequency of adhesions following gall-bladder surgery than elsewhere in the abdominal cavity

Not only are adhesions constantly present after drainage, but their extent and severity are often entirely out of proportion to the primary pathology and the nature of the operation done

The effect of gall-bladder adhesions in producing subsequent symptomatology varies markedly in different individuals. In cases with severe pathology, such as acute cholecystitis with stones, the relief obtained from simple drainage is often complete and permanent, while in others with only a mild but definite cholecystitis, the results of operation, so far as local comfort is concerned, are not infrequently disappointing. The fact, however, that adhesions undoubtedly follow both of these types, leads one to the conclusion that variations in the degree of post-operative discomfort are to a certain extent dependent upon the patient's temperament, in other words that the relative relief in the one class is so great as to cause less severe symptoms to be overlooked, while in the other the disposition of the individual tends toward exaggerating his complaint

During the past few years, I have been struck with the number of our cholecystostomies returning to us for treatment, and furthermore the literature on the subject convinces me that this operation has, in the hands of other surgeons, proven unsatisfactory in a considerable proportion of cases. This fact has been largely responsible for popularizing the operation of cholecystectomy which is now being widely advocated

I have thought for some time, although I have never tried to prove my belief, that bile would stimulate adhesions if it came in contact with tissues not surrounded by epithelium. With this in mind, and also keeping before me the failure on the part of cholecystostomy to alleviate certain low-grade infections of the gall-bladder, I have been conducting in dogs a series of experiments which for all practical purposes may be divided into five groups: (1) Cholecystectomy without the spilling of bile in the abdominal cavity; (2) Cholecystectomy with the emptying of bile in the abdominal cavity; (3) Cholecystotomy with drainage; (4) Cholecystectomy with bile infected with *B. typhosus* smeared over gall-bladder area. No drainage; (5) Cholecystostomy in a gall-bladder previously infected with *B. coli*

If my results are to be relied upon, I think it reasonable to assume that in some dogs bile may stimulate a moderate amount of adhesions, while in other dogs bile may institute a profuse fibro-elastic tissue reaction in the peritoneal cavity

## A MURAT WILLIS

*Experiment 1*—Control Cholecystectomy without the spilling of bile and without drainage

(a) Mongrel, bitch, puppy Cholecystectomy September 13 Died with distemper October 3 No adhesions Nine days

(b) Mongrel, dog, puppy Cholecystectomy September 23 Died with distemper October 3 No adhesions Ten days

(c) Bull, bitch, puppy September 23 Killed October 20 No adhesions Twenty-seven days

(d) Fox-terrier, dog Cholecystectomy September 23 Killed October 20 Few adhesions about the liver in gall-bladder region Twenty-seven days

In this series only one dog exhibited adhesions, and these were insignificant Other dogs dying at nine, ten and twenty-seven days respectively showed no adhesions

*Experiment 2*—Cholecystectomy Contents of gall-bladder emptied into abdominal cavity

(a) Mongrel, bitch Cholecystectomy September 22 Died with distemper October 1 Numerous fresh adhesions about the gall-bladder region Eight days

(b) Fox-terrier, bitch Cholecystectomy September 22 Killed October 20 No adhesions Twenty-eight days

(c) Fox-terrier, dog Cholecystectomy September 22 Killed October 20 Few adhesions about stomach, liver and duodenum Twenty-eight days

(d) Mongrel, dog Cholecystectomy September 22 Killed October 20 Stomach, liver and colon matted together with numerous adhesions Twenty-eight days

In this series one showed no adhesions at the end of twenty-eight days Two showed a moderate number of adhesions on the eighth and twenty-eighth day respectively, and one showed numerous adhesions on twenty-eighth day

*Experiment 3*—Cholecystostomy with drainage

(a) Shepherd, bitch, puppy Cholecystostomy September 24 Died with distemper October 6, 1915 Numerous adhesions in gall-bladder region Twelve days

(b) Mongrel, bitch Cholecystostomy September 24 Numerous adhesions about stomach, liver, small intestines, anterior abdominal wall, etc Twenty-six days

(c) Fox-terrier, bitch Cholecystostomy September 24 Killed October 20, 1915 Numerous adhesions in gall-bladder region Twenty-six days

(d) Mongrel, bitch, puppy Cholecystostomy October 1 Killed October 20 Liver, stomach, duodenum, colon and omentum matted together with numerous adhesions

In this series three showed numerous adhesions on the sixth, twenty-sixth and twenty-sixth days respectively, and one showed a veritable mass of adhesions on the ninth day

In the above experiments normal bile was employed We thought it well to inject *B typhosus* and *B coli* into the gall-bladder, and later to spill some of the bile in the abdominal cavity in the region of the gall-bladder

## ADVANTAGE OF CHOLECYSTECTOMY

*Experiment 4*—Cholecystectomy with bile infected with *B typhosus* smeared over gall-bladder area No drainage

(a) Mongrel, bitch, puppy Cholecystectomy October 12 One-half c.c. of the bile culture of typhoid fever smeared over gall-bladder area Killed November 1 Many adhesions in gall-bladder region

(b) Mongrel, dog Cholecystotomy October 12 *B typhoid* injected into gall-bladder Cholecystectomy October 20 No drainage Small amount of bile spilt at seat of operation Autopsy November 7 Many adhesions in gall-bladder region

We did not drain the dogs injected with typhoid because of the danger attached to such a procedure

*Experiment 5*—Cholecystostomy in a gall-bladder previously infected with *B coli*

(a) Mongrel, dog Cholecystotomy October 12 *B coli* injected into the gall-bladder Cholecystostomy October 20 Autopsy November 7 Adhesions in upper abdomen numerous Greatest number at gall-bladder area

(b) Mongrel, bitch Cholecystotomy October 15 *B coli* and *Staphylococcus aureus* injected into gall-bladder Cholecystostomy October 24 Autopsy November 12 Stomach, liver, etc., were matted together with adhesions

In series four and five the number of adhesions was greater than in the preceding experiments where normal bile was used

It is not always easy to recognize a diseased gall-bladder Chronic catarrhal inflammation, or the so-called strawberry condition, may exist, and yet viewed from the serous surface the gall-bladder looks and feels perfectly normal, and it empties with little or no difficulty

What shall we do for these individuals if their symptoms point to a gall-bladder infection? Shall we explore and drain the gall-bladder? Shall we remove it? Shall we leave it alone?

The ideal operation would be to explore these uncertain gall-bladders, and if no pathology be present close them and drop back into the cavity However, it is impossible to open and explore a gall-bladder without soiling the surrounding peritoneal surfaces with bile Therefore, this exploration is followed by crippling adhesions regardless of whether the gall-bladder is diseased or healthy, or whether it is followed by cholecystectomy or cholecystostomy

In my judgment the gall-bladder should not be explored by incision, but in those uncertain cases it is better to do a cholecystectomy without drainage

In a well-performed cholecystectomy where no bile is spilt in the cavity and no drain of the liver is used, the trauma of operation seems to be an insignificant factor in stirring up adhesions On the other hand, in cholecystostomy and cholecystectomy where we use a drain, and have a spilling of bile, adhesions invariably follow We all know that foreign bodies stimulate a production of fibro-elastic tissue, from the results of my experiments, I feel that bile is an important factor in the production of adhesions, and that it is of the utmost importance that the irritating and often infected bile should not be allowed to come in contact with peritoneum



## POSTURE IN CASES OF ABDOMINAL DRAINAGE\*

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It is a generally recognized fact that the posture in which patients are placed after operations for septic abdominal conditions, is an important factor in their recovery. It is well to remember that surgery demanding abdominal drainage is the surgery of delay. Oftentimes the vitality of a patient is seriously impaired before the case is turned over to a surgeon, and the margin tending towards a safe operation may be very small or entirely absent. In all cases where drainage is necessary, there is one vitally important point to be kept in mind, and that is the fact that drains are usually effectual for but a little more than twenty-four hours. Their effectiveness is at its maximum immediately after operation, and this tends to lessen from hour to hour. Unless sufficient drainage takes place in the first few hours, the patient is likely to die from peritonitis or sepsis. It will thus be seen that in the gravest surgical cases it is of the utmost importance to secure at once an unobstructed outflow of all toxic fluids from the abdomen. It must also be remembered that a drain is likely to affect only a small area. Consequently, a number of drains must be used.

The various methods of drainage of the abdomen that have been employed at different times, are familiar to all. The first really great advance towards modern methods of abdominal drainage, was outlined in a paper read by Dr. Murphy, at the Atlantic City Meeting, of the American Medical Association, some years ago. Murphy at that time reported 16 cases of appendicitis with peritonitis, with 15 recoveries. His paper was accepted with marked reservation and it was only after years of experience that we realized his ideas were in the main correct. He advocated the Fowler or sitting position and the use of normal saline by proctoclysis, so as to convert, as he said, the peritoneum from an absorbing to a secreting surface. Dr. Murphy considered the Fowler position of first importance, because it allowed all fluids to gravitate into the pelvis, where the activity of the lymphatics is not so great as in the region of the diaphragm. By keeping the patient in an elevated position all fluids are thus brought into the pelvis and enabled to escape more readily by means of a drain placed in the cul de sac of Douglas. The lower rate of absorption in this region allows more time for the peritoneum to dispose of all poisons that are not expelled through the drain.

The greatest factors in abdominal drainage are gravity, intra-abdominal pressure, and capillary attraction. Of these, undoubtedly, the most im-

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\* Read before the Western Surgical Association, December, 1916

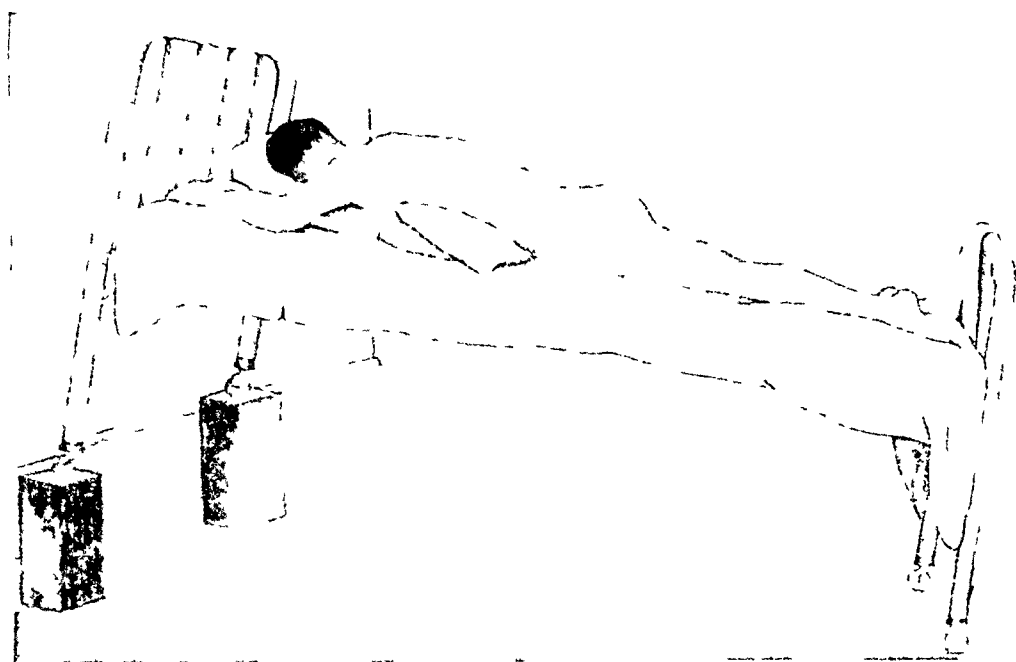


FIG 1

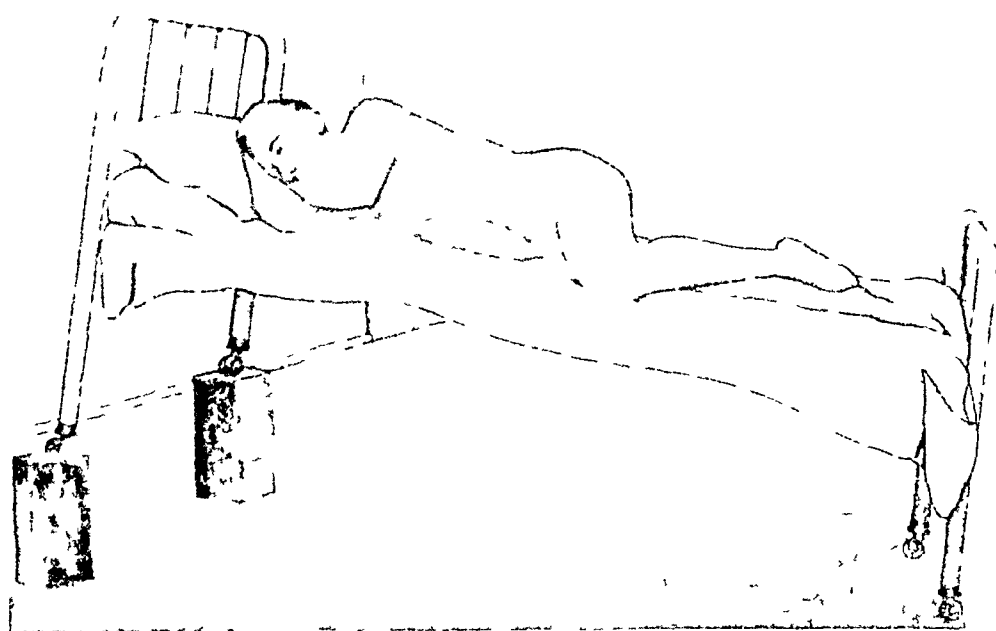


FIG 2



portant is gravity, the full value of which we do not believe has always been secured. There are three definitely recognized positions used in treating these cases, and each seeks to secure to the utmost the influence of gravity. These positions are. 1st, The Fowler position as advocated by Fowler and later by Murphy. 2d, The prone position, or what is known as ventral decubitus. 3d, The lateral position, where the patient is placed on the side. The Fowler position is the one most commonly employed throughout the country. It has a number of disadvantages that must be taken into consideration. As Coffey has shown, it is necessary to raise the patient so that the long axis of the abdominal cavity is at an angle of 60-70 degrees on the horizon, before the spaces in front of the kidneys will drain into the pelvis. This position tends to throw a decided strain upon a patient with an already weakened heart and lowered blood pressure. Furthermore this position favors gastric distention with its associated ill results. Moreover in the Fowler position the pelvis is lower than the pelvic arch and the escape of pus takes place by siphonage.

In regard to the prone position, some years ago one of the resident staff at the St. Louis City Hospital made the observation, that he thought if a patient were placed on the abdomen, drainage would be more effectual than in any other way. The plan looked feasible and was tried out so successfully that a number of the staff now use it as a matter of routine. As it is now carried out the patient is placed on the abdomen usually for from twenty-four to forty-eight hours, with the head of the bed elevated about 10 or 12 inches. A pillow is placed under the lower part of the chest, and one is placed under the head, so as to give the patient ample room to breathe. The principal objection to this position is that it is not comfortable. Our observations lead us to believe, however, that it is not nearly as uncomfortable as one would suppose. By this position we get the maximum effects of gravity, intra-abdominal pressure, and capillary attraction. In addition to this there are no spaces in the front of the abdomen to favor the formation of pockets, as there are in the pelvis and alongside of the spine. The pus is also brought against an area of the abdomen where blood-vessels and lymphatics are not nearly so numerous as they are in the pelvis. We believe this to be a very important factor, as it would seem that absorption would take place more slowly here than in any other part of the abdomen.

The lateral position, in which the patient is placed on the right side, we have found to be very efficient. In this position the head of the bed is slightly elevated, and a pillow is placed under the region of the liver, so as to prevent any space for accumulation of fluid in the kidney region. The patient is turned over far enough so that pus will drain from in front of the left kidney. In a series of interesting experiments on the cadaver, Dr. Coughlin has shown that this posture when properly employed will probably allow a more perfect escape of fluid than any other.

In an analysis of 104 drainage cases that have been operated upon at the St. Louis City Hospital during the last year and a half, I find that the

three positions have been employed with sufficient frequency to warrant us in drawing some conclusion as to the relative merit of each

In a series of 15 cases treated in the lateral position, there was an absence of mortality. Of these 15 cases there was one of eight months pregnancy, with ruptured gangrenous appendix and peritonitis, there were six cases of acute appendicitis with perforation, four cases of appendiceal abscess, and four cases of acute appendicitis.

In a series of 42 cases treated in the abdominal position, there were but two deaths. An analysis of this series shows that in eleven cases localized abscesses had formed. Nineteen are recorded as cases of perforated appendicitis, and in addition to this there were five cases in which general peritonitis had developed. Seven cases were cases of acute appendicitis, and of these all but one were gangrenous or suppurative.

In the 47 cases treated in the Fowler position there were five deaths. An analysis of this series shows that there were ten cases of appendiceal abscess, seven cases of perforated appendicitis with general peritonitis, and eight cases of ruptured appendix. Seventeen were cases of acute appendicitis and one was a case of acute appendicitis with pelvic peritonitis. Two were cases of chronic appendicitis (evidently recurrent cases). One with cholecystitis is recorded. There was one case of general peritonitis with abscess of liver, and one case is listed as progressive peritonitis.

In the treatment of these cases, peristalsis is controlled by the use of opiates and absolutely nothing is given by the mouth. The necessary water is introduced into the system by the Murphy method. Formerly we used normal saline, but in view of the fact that salt puts some strain on the kidneys, we now use a solution of glucose and soda. Glucose is a carbohydrate of high caloric power that is easily burned off in the system and tends to keep up the strength of the patient. The soda is added because of the tendency to acidosis that follows all severe cases. Formerly we used bicarbonate of soda, but lately we have been using the citrate. The strength of the solution is 3 per cent glucose and 2 per cent soda solution.

The materials used in drainage of abdominal cases, I believe to be important. Formerly glass tubes were employed, but it was found that they had two distinct disadvantages. First, They were hard and would tend to ulcerate through the bowel and form a fistula if left in too long. Second, They have also been known to break off inside of the abdomen. This happened in a case of my own in which I operated upon a colored man for five perforations of the small intestine caused by gun shot. The peritoneum was opened, the perforations repaired and a glass tube inserted into the pelvis. A few days later in removing the glass tube I found that it had broken off and a part of the tube almost two inches or more was left in the abdomen. This necessitated a further operation which fortunately was successful and the patient recovered. At the present time we prefer a large slit rubber tube with a small wick in it with one or two additional drains of rubber dam wrapped around wicks of gauze after the plan suggested by Robert T. Morris of New York.

## POSTURE IN CASES OF ABDOMINAL DRAINAGE

In conclusion I wish to state that I believe posture to be an important factor in the recovery of the severe cases of abdominal drainage. At the same time the whole after treatment is of the greatest importance, and the position alone will be of no avail unless the giving of food by the mouth is strictly prevented. In fact the principles of the so-called Ochsner treatment should be most vigorously applied after operation if we are going to secure the best results in these very interesting and but too often desperate cases.

In closing I wish to emphasize the fact that the series of cases reported here came from a stratum of society where personal neglect is the rule. Many of these patients were poorly nourished and sadly neglected and entered the hospital only as a last resort. If we take these facts into consideration and then remember that there were only two deaths out of 57 cases treated in the prone position and on the side, I think you will infer not only that the record is an excellent one but that the posture in which the patients were placed contributed materially to their recovery.

# OPERATIVE TREATMENT OF HOUR-GLASS STOMACH

WITH REPORT OF A CASE TREATED BY DOUBLE POSTERIOR GASTRO-ENTEROSTOMY

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(From the service of Dr Charles L Gibson, Cornell Surgical Division of the New York Hospital)

THE operative treatment of hour-glass stomach dates from 1889 when Bardeleben first performed a gastropasty with a fatal result. Gastropasty was later successfully performed by Krukenberg in 1892. This operation, alone, can only be performed when the pylorus is normal, and in a study of a series of cases treated in this manner Patterson found that in at least twenty-five per cent the remote results were very poor.

Gastrogastrostomy, first performed by Wolfer in 1894, is likewise unsatisfactory and in addition is dangerous in the presence of much tension.

Digital divulsion or dilatation is no longer considered a justifiable procedure, although a few cases have been reported with moderate success.

In a small percentage of cases the constriction is caused by cancer and here resection should be performed if practicable.

Posterior gastro-enterostomy using the cardiac pouch may be performed with success providing the pyloric pouch is relatively small and the pylorus is normal.

In view of the fact however that many cases of hour-glass stomach due to ulcer also have similar lesions at the pylorus, it is evident that no single operation will effect a cure. It has therefore been the custom of many surgeons to combine posterior gastro-enterostomy or pyloroplasty with either gastrogastrostomy or gastropasty.

Von Hacker, in 1895, and Weir and Foote,<sup>1</sup> in 1896, suggested double posterior gastro-enterostomy in the treatment of hour-glass stomach. Hartmann reported a case with successful result before the International Surgical Association in April, 1914, and another case was reported by Van Beuren<sup>2</sup> before the New York Surgical Society, November, 1916.

In view of the fact that gastropasty is often unsuccessful in widespread ulcer and gastrogastrostomy is relatively dangerous in the presence of much tension it would seem that double posterior gastro-enterostomy is a logical operation and is definitely indicated in certain cases. Because of the rarity of such cases in the literature it has seemed advisable to publish the following successful case.

M D, woman, aged forty-two, Irish, housewife, was referred to the Cornell division of the New York Hospital for gastric study by Dr Thos Stone, February 5, 1917, on account of epigastric pain, vomiting and loss of weight. Her family history has no bearing on the case.

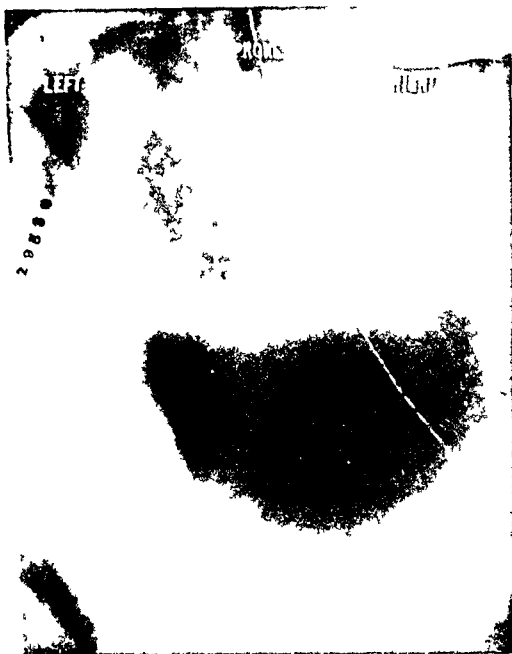


FIG 1 —Rontgenogram of stomach before operation immediately after ingestion of bismuth, showing great dilatation of pyloric pouch Position in photograph is reversed



FIG 2 —Rontgenogram of stomach before operation, taken twenty-four hours after ingestion of bismuth, showing retention in pyloric pouch



FIG 3 —Rontgenogram of stomach three months after operation, showing hour-glass contracture and bismuth in both pouches Position in photograph is reversed





FIG 4—Rontgenogram of stomach three months after operation, taken one hour after ingestion of bismuth, showing both gastro enterostomy openings working well Position in photograph is reversed

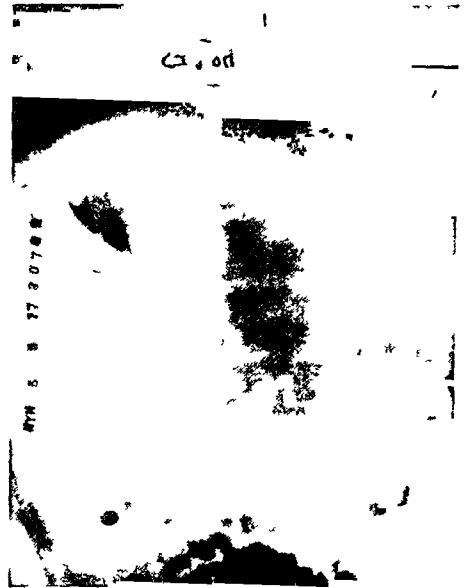


FIG 5—Rontgenogram of stomach three months after operation taken five hours after ingestion of bismuth, showing stomach practically empty Position in photograph is reversed

## OPERATIVE TREATMENT OF HOUR-GLASS STOMACH

*Past History*—She has always been well except for attacks of measles and pertussis in childhood. During the past thirteen years she has been troubled with carious teeth and pyorrhœa. Aside from chronic constipation she has had no gastro-intestinal symptoms previous to the onset of present illness. She received a perineal laceration at the birth of her first child ten years ago and suffered from a uterine prolapse for several years until May, 1916, when she was operated upon in another clinic, operation consisting of perineorrhaphy, ventral fixation of uterus and appendectomy. Her average weight was one hundred forty pounds until about five years ago when she began to lose weight, which she attributes to the prolapsed uterus and accompanying symptoms. In 1915 she weighed one hundred twenty-one pounds. Previous to admission she weighed about eighty pounds.

*Present Illness*—Began two and one-half years before admission with epigastric pain accompanied by gaseous eructations, occurring about three hours after the noon-day meal and continuing until about eleven P.M. Her symptoms gradually increased in severity. Pain was relieved by vomiting and by taking sodium bicarbonate until about one year before admission when these measures ceased to give relief. No hæmatemesis or melæna. Patient has recently noticed splashing in stomach and peristaltic movements in upper abdomen. Five weeks before admission pains came on three to four hours after breakfast and were so severe that she was unable to eat dinner or supper. During this time she lost weight rapidly.

*Physical Examination*—Fairly well developed medium sized woman who is markedly emaciated, appearing chronically ill. Skin and mucosæ are slightly pale. Heart and lungs are normal. Abdomen is relaxed and scaphoid. There is a bulging tympanitic area in upper half of abdomen corresponding to the position of a dilated stomach. Here peristaltic movements can be seen traveling from left to right and ending under right costal border. Clapotage present. There is a palpable movable mass about the size of a lemon just above and to right of umbilicus. Liver and spleen are not palpable. Kidneys are just palpable. Genitals normal. Knee jerks are present and equal. Wassermann test in blood negative.

As her symptoms were obviously gastric in origin she was at once referred to the department of roentgenology and a barium series of plates were taken, which definitely showed an hour-glass stomach (Figs 1, 2, 3).

*Operation* (February 10, 1917) —By Dr Charles L. Gibson, Laparotomy to the right of midline five inches long. There is a huge stomach, the pyloric pouch of which is about three times the size of the cardiac pouch. The constriction between the two pouches is due to cicatrization of a large ulcer which forms a tumor nearly the size of a hand. Pylorus is obstructed by a similar large callus, apparently cicatrized ulcer. A small node lying on the pylorus was excised for examination (Microscopical report-normal). Double posterior gastroenterostomy is done, one in the cardiac pouch without clamps using five rows of sutures, three posteriorly and two anteriorly using silk for the first and last and fine chromic gut for the other three. The same

loop of intestine is used five inches away for a second gastro-enterostomy in the pyloric pouch a little more than midway in the pouch, nearer to the pylorus This gastro-enterostomy done with tongue depressor clamps,<sup>3</sup> otherwise technic the same Suture of incision in mesocolon to stomach in both instances Closure of abdominal wall in tiers reinforced by four silkworm-gut sutures

*Subsequent Course*—Recovery uneventful On the sixth day patient was taking soft-solid diet and on the tenth day she sat up in a chair Weight twelve days post-operative, eighty pounds Discharged March 5, 1917, having gained about a pound a day and absolutely free from symptoms

Patient returned in the follow-up clinic<sup>4</sup> on May 7, 1917 She is absolutely free from symptoms, feels well and has gained thirty-two pounds in weight A second barium series taken of the stomach shows that the stomach empties rapidly, being nearly empty at the end of one hour and that it is practically free from barium at the end of five hours Both gastro-enterostomy openings are working well (see Figs 1-5)

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# THE EXTENT OF TISSUE TO BE EXCISED FOR A RADICAL REMOVAL OF CARCINOMA OF THE STOMACH

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AND

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THIS investigation was made for the purpose of determining the minimum amount of tissue adjacent to small carcinomata of the stomach wall which must be resected in order to secure a complete operative removal of the malignant process in those cases in which the regional lymph-nodes apparently are not involved and in which there are no demonstrable metastases

The material studied consisted of gastric carcinomata removed by pylorotomy or by partial gastrectomy In two cases where an inoperable carcinoma was found at operation the entire stomach was secured at autopsy, and in a third case where the first stage of an operation for carcinoma of the cardia was performed the specimen was also secured post mortem

The specimens studied were selected from a large number, most of which were rejected because the extensive malignant involvement rendered them unsuitable for the purpose of this investigation Several of the specimens were chosen for examination because the tumor was so situated that its mode and degree of extension could be studied, even though the carcinoma was too large to be operable

The specimens were fixed immediately in ten per cent formalin, and subsequently blocks were cut in directions radial and tangential to the tumor proper, both through the edges of the tumor and at various distances from it The accompanying diagrams are self-explanatory, and show the position of the blocks The extent of the malignant involvement is indicated by dotted areas

*Specimen T W 1* (Fig 1) —The specimen was obtained at post-mortem examination and consisted of the entire stomach in two parts (At operation the stomach was divided in two, both ends were closed in and a gastrostomy was established into the pyloric part) A large cauliflower-like tumor arises from the lesser curvature and extends downward on the anterior and posterior walls surrounding the cardiac orifice and on to the wall of the œsophagus for a distance of 3 cm above the diaphragm

*Specimen T W 3* (Fig 2) —The specimen consisting of œsophagus and stomach was obtained at autopsy The œsophagus was normal The stomach

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\* This study was carried on under the tenure of a Moses Heineman Fellowship

presents an hour-glass appearance with the contraction three-quarters of the way from the fundus to the pylorus, on the lesser curvature. Fibrous bands upon the serosa extend radially from the tumor. On opening the stomach the contraction is found to allow the entrance only of the tip of the little finger. On section a puckered, centrifugally-extending growth is seen on the anterior wall, and an ulcerating vegetating growth, connected to the former by a submucous band, on the posterior wall.

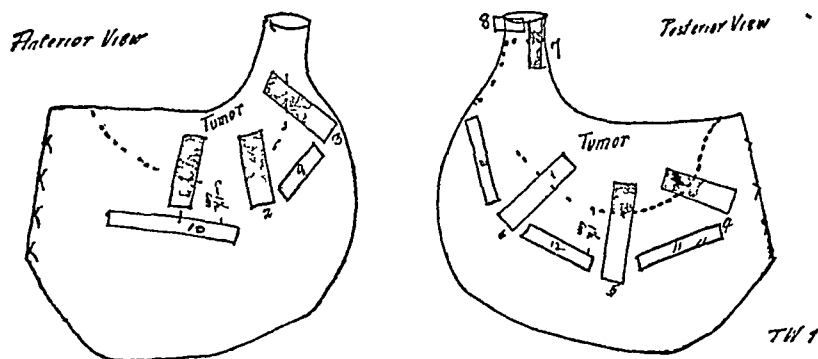


FIG 1

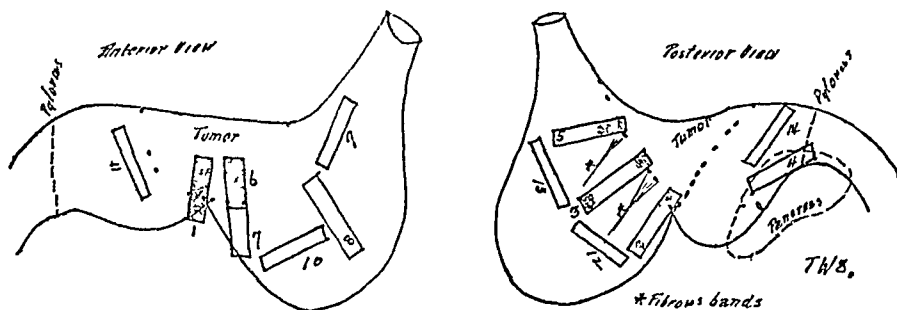


FIG 2

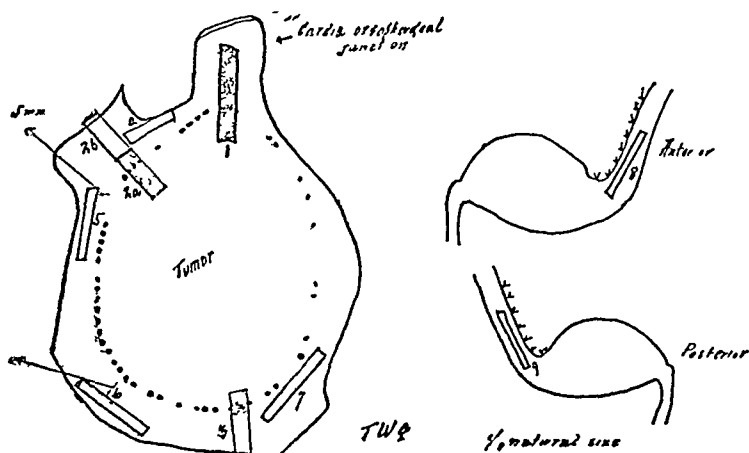


FIG 3

*Specimen TW 4* (Fig 3) — Specimen was obtained at operation and consists of the lower 2 cm of the œsophagus and the adjacent portion of the stomach for a distance of 7 cm along the lesser curvature. A cauliflower-like tumor occupies practically the entire surface of the mucosa except for a short area about 1 cm in width, which corresponds to the posterior wall of the œsophagus at the cardio-œsophageal junction. The line of section is from 1 to 3 cm beyond

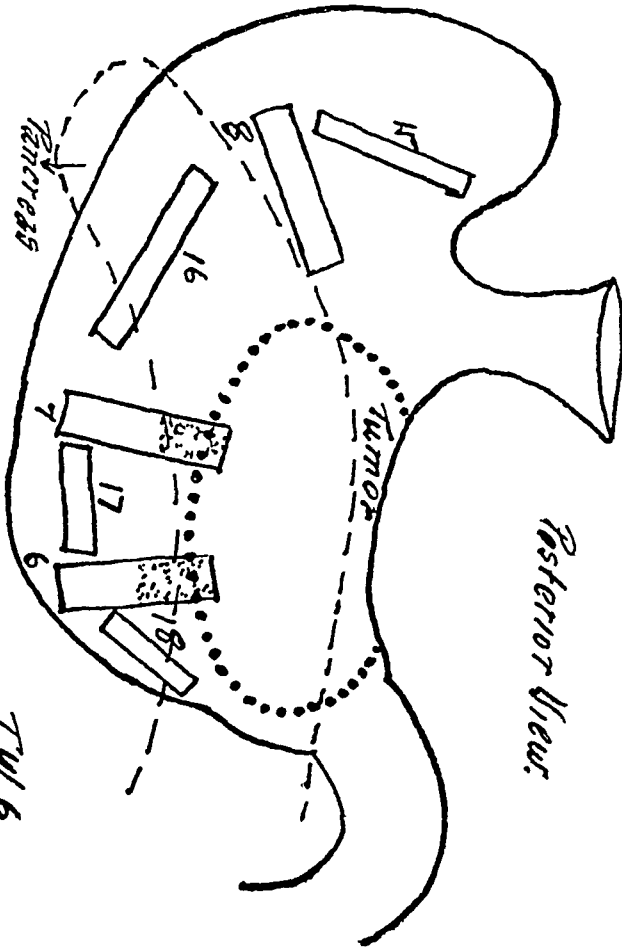
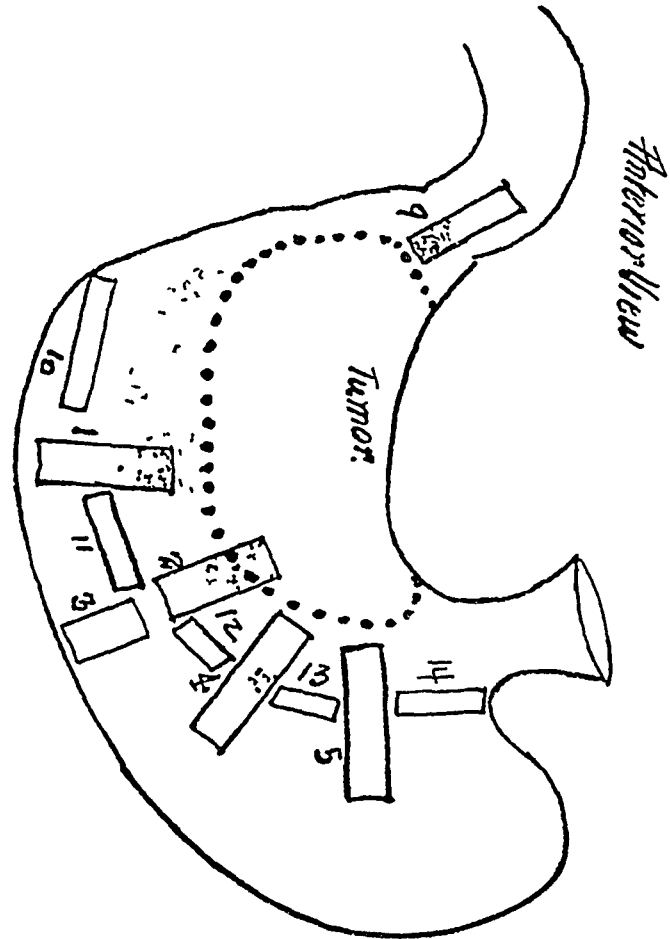


FIG 4

T.W. 6.

the margin of the tumor The remainder of the stomach was obtained at post-mortem examination, and was free of tumor

*Specimen T IV 6* (Fig 4) —Specimen was obtained at post-mortem examination and consisted of the entire stomach, the first part of the duodenum, the stump of the oesophagus and that portion of the pancreas underlying the posterior stomach wall Except for a distance of several centimetres at the cardiac end, the entire extent of the lesser curvature up to 1 cm from the pyloric ring is occupied by a saddle-shaped tumor extending downward on the anterior and posterior walls half way to the greater curvature Near the pyloric ring the tumor encircles the entire lumen

*Specimen T W 7* (Fig 5) —The specimen was obtained at operation and consists of a circumferential segment of the middle portion of the stomach about 25 cm in width (Resection in continuity) Directly on the lesser curvature is a punched-out, ulcer-like lesion reaching downward into the muscularis The edges of this resemble a benign ulcer Microscopically this proved to be carcinoma There was no lymphatic involvement

(Many blocks, which are not charted, were sectioned for the purpose of a

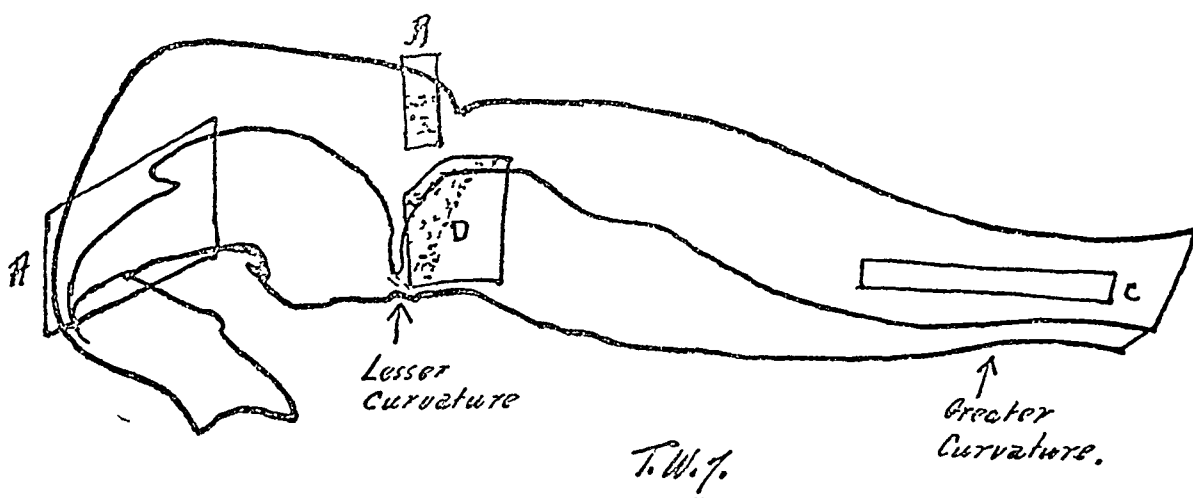


FIG 5

different investigation and no tumor was found beyond the area indicated in the figure)

*Specimen T W 9* (Fig 6) —The specimen was obtained at operation and consists of the pyloric two-thirds of the stomach At the middle of the lesser curvature extending downward on the anterior wall is a punched-out defect about 4 cm in diameter Along the edge of this opening, small grayish nodules are seen, and the wall of the stomach bordering the defect is thickened for a considerable distance The tumor reaches within a few centimetres of the greater curvature on both the anterior and posterior walls and reaches almost as far as the pylorus

*Specimen T W 10* (Fig 7) —The specimen was obtained by pylorectomy and consists of the pyloric antrum The tumor is 5 cm in diameter and surrounds the pylorus

*Specimen T W 12* (Fig 8) —The specimen was obtained at operation and consists of the pyloric two-thirds of the stomach On the posterior wall close to the lesser curvature is a large perforation 3 cm in diameter The lymph-nodes along the lesser curvature are hard and shot-like

*Discussion* —When a carcinoma is situated at or near the pylorus, a pylorectomy accomplishes the removal of the tumor-bearing area

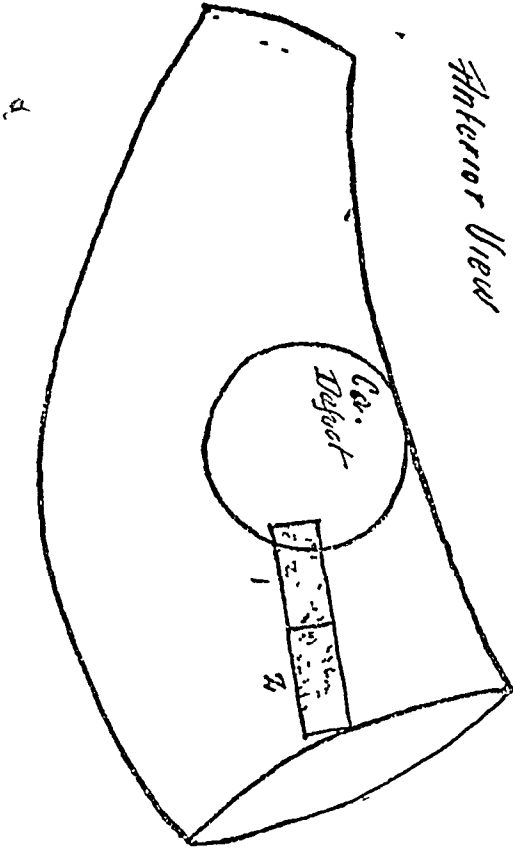


FIG 6





Nevertheless, in many instances the surgeon is able to go only a very short distance beyond the macroscopic limits of the growth on the duodenal side of the tumor. Since a certain number of these cases do not have local recurrences, it is evident that this narrow margin of safety is sufficient in excision of pyloric carcinomata.

When the carcinoma is situated some distance from the pylorus the surgeon has been guided by his experience with pyloric neo-

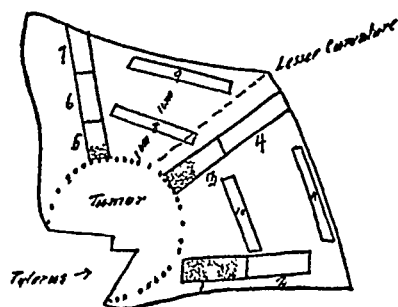


FIG 7—T W 10

plasms, and in order to remove the tumor has had to perform a partial gastrectomy including the pylorus and a large part of the stomach as well. This is a very extensive procedure, is associated with great risk to the patient, and leaves a deformed and small segment of the stomach.

The results of the present study show that in only one instance (T W 3, block 3) was carcinoma found microscopically more than

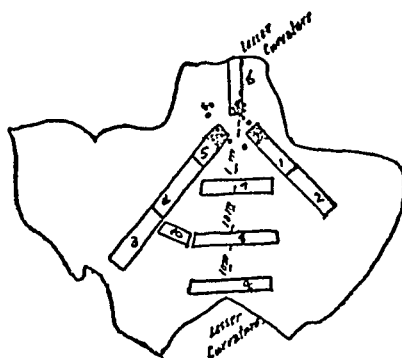


FIG 8—T W 12

one centimetre beyond the macroscopic limits of a local carcinoma of the stomach. In this one instance the tumor, although local in nature, was nevertheless a large one and was attended by considerable cicatrization in the form of fibrous bands extending in a radial direction. As the degree of extension in this case is contrary to that found in the other specimens, it seems possible that the extension here may have been along one of the fibrous bands, even though this could not be verified.

The findings in the study of the specimen T W 9 show the wide

## RADICAL REMOVAL OF CARCINOMA OF STOMACH

involvement of the stomach in carcinomata of the diffuse type. These results are introduced for the sake of contrast with those obtained in local carcinoma of the stomach wall.

From the evidence submitted, it is justifiable to conclude that in small carcinomata of the stomach, situated elsewhere than at the pylorus, the malignant process is so limited in extent that local resection at a distance from one to two centimetres beyond the macroscopic limits of the tumor will in the majority of instances remove the entire tumor. Even in some of the comparatively large tumors included in the present study there was no extension of the tumor detectable by the microscope beyond this limit.

It must not be assumed from these observations that the accepted methods of surgical treatment of carcinoma of the stomach, such as a pylorectomy or partial gastrectomy, are not necessary for a thorough removal of the diseased tissue. It must be emphasized that such methods should be employed wherever possible.

The clinical significance of these investigations is twofold.

1 Inasmuch as the surgeon frequently makes a local excision of an ulcer in the belief that the latter is benign in character, these investigations show that such a local excision is sufficient for a radical removal of the malignant process even if subsequent pathological examination shows the ulcer to have been carcinomatous in character. Of course such a local excision would be radical only when metastatic glandular involvement is not present.

2 When a malignant tumor is situated at the cardiac end of the stomach, at present the surgeon may either do a complete gastrectomy or consider these cases inoperable. The serious consideration of complete gastrectomy is almost forbidden in these cases because of the high mortality of this operation. Local excision of the tumor is a far less dangerous procedure, and, since the above investigations have shown that such local excision is sufficient for the removal of the malignant process, these tumors become accessible for radical operative treatment. Of course such excision is only radical provided no metastases are present.

In the future we shall continue to examine all specimens of small gastric carcinomata removed by local excision to determine the extent of involvement and this information and the post-operative course will be reported upon in subsequent communications.

# HYPERPLASTIC PYLORIC STENOSIS

By DUDLEY W PALMER, M D

OF CINCINNATI, OHIO

SURGEON TO THE CINCINNATI GENERAL AND THE CHRIST HOSPITAL

My reason for presenting this subject is fourfold, first, I believe this condition has been and is frequently overlooked, second, I wish to bring out some of the essential features in the diagnosis, third, to comment on some of the surgical features and complications, and last, to emphasize the fact that most excellent results are obtained by surgical intervention with comparatively slight risk, and to report my cases

Dr E W Mitchell, at the 1916 Cleveland meeting of the Ohio State Society, quoted the first clinical description, written in 1788. The quaintness and clearness of this description make it worth anyone's reading. From that time until quite recent years little has appeared in the literature, but the volume of material now at hand will astound one at his first investigation. The number of reported cases is also increasing in almost arithmetical progression. This means but one thing, and that, that we are just beginning to recognize congenital hyperplastic stenosis as an entity. My own little experience has furnished more cases for operation during the last eighteen months than had previously been operated upon in all Cincinnati, and when one man (Downes of New York) reports over seventy-five cases in the last five years, we can logically conclude that many undiagnosed cases have died, either directly because the pyloric obstruction led to starvation, or indirectly because the pyloric narrowing produced a malnutrition that lowered the body resistance to other diseases.

In an earlier paper I called attention, at length, to the pathology and endeavored to prove that practically all cases of congenital pyloric obstruction have a constant pathology that rests on a far more tangible basis than any "spasm" theory. The spasm explanation is too elusive to satisfy the materialistic doctor of to-day, and I have only to point out the similarity of the obstruction symptoms produced by prostatic obstruction and congenital pyloric hyperplasia, to prove the inability of spasm alone to produce the syndrome we have learned to look for in the latter condition. Prostatic hypertrophy is often present long before sudden obstruction, and yet one does not attribute the sudden obstruction to simple spasm. It is the congestion associated with a "spree," sudden chilling, instrumentation, etc., that is the last straw to close the already narrowed calibre of the urethra, surrounded by the enlarged prostate. So also the oedema from increased muscular effort, or a fold of mucous membrane, a curd of milk, may be the factor to close a pylorus already narrowed by too great an

amount of sphincter muscle I am not attempting to explain the cause of the hyperplastic muscle (note I use hyperplastic not hypertrophic), but experiments are being carried on in Chicago in an endeavor to throw light on this phase of the subject. It is a fact, however, that I wish to make plain, that in this entire group of congenital pyloric cases there is present some hyperplasia of the circular muscle fibres, this may be just enough to be barely distinguishable from normal, or it may be so great as to practically close the pylorus. All grades between, naturally exist. One does not expect to find in any case a complete anatomical obstruction for "complete occlusion of the pylorus produces death in animals in from forty-eight to one hundred and twenty hours" (*Arch of Int Med*, 1914, xiv, p 722). There are cases having a medium amount of pyloric hyperplasia and clinically showing intermittent attacks, or periods of obstructive vomiting, which gradually disappear because the gastric muscle is able to hypertrophy enough to force the food through the incompetent pylorus, and it may be, a "used" pylorus will dilate somewhat, it is surely not a far-fetched simile to compare these cases with the cases of overloaded leaky hearts that after proper hygienic care and medication become so well compensated as to show no more symptoms. I believe the cases of so-called congenital pyloric spasm that are cured are mild cases of pyloric hyperplasia, and the intermittent symptoms can be accounted for by the explanation offered above. Experimentally "partial pyloric stenosis in dogs produces hypertonicity and hypermotility of the stomach, even if of but a few days' or weeks' duration" (Elsesser, *Am J of Physiology*, vol xxxix, p 303).

I shall not go into the symptomatology except to bring out some of the diagnostic features. A large majority of the cases are first-born males, breast fed, and perfectly well at birth. The parents are usually well and free from any detectable constitutional disease. Depending on the amount of hyperplasia of the pylorus, above referred to, the vomiting, beginning in the first days of life, or at least in the first few weeks, may be part or all of the ingested food. It is of an obstructive, forceful, explosive type, and the vomitus is expelled a foot or two through the mouth and nose. It consists of ferment-curdled milk and is never bile stained. It occurs most often soon after nursing, but in the late cases the dilated stomach may hold several feedings. The feeding and vomiting spells are associated with unmistakable evidence of abdominal pain, and, even though the infant does not vomit, it is very restless at such times. With the above symptoms, the doctor should at once expose the abdomen and look for the gastric contracting muscle waves, that are the most important diagnostic symptom. These show themselves as small rounded elevations that form at the left costal arch and travel slowly across the abdomen to the right hypochondrium, where they disappear. The size, rapidity

of movement, frequency and visibility of these muscle waves vary greatly with the tone of the gastric muscle (not being present in the late atonic starved out case), with the amount in the stomach, the degree of the obstruction, the thickness of the subcutaneous fat layer, and other disguising conditions

In a percentage of all cases, even those where the obstruction is the most acute, it is impossible to palpate the pyloric tumor because of the overhanging liver or the posterior position of the pylorus. If the tumor is palpable it cinches the diagnosis, if not palpable it by no means negatives the diagnosis, often the tumor becomes palpable after the little patient is anæsthetized

All other symptoms are dependent upon the obstruction to the passage of food and fluids with the consequent malnutrition and dehydration. These infants may lose weight so rapidly as to verily melt away before one's eyes. Diagnosis should mean surgical intervention except in the milder cases. The milder cases may or may not be surgical, depending upon whether or not the gastric power becomes sufficient to overcome the obstruction, and upon how often the stomach develops or shows signs of broken compensation. These latter cases will tax the judgment of the best men, and a case thought to be medical at one time may later become surgical or *vice versa*.

A certain few cases belong in the class of emergency or urgent surgery, because of the acuteness of the symptoms and completeness of the obstruction. If the stools indicate there is considerable food passing the pylorus and weight is not being lost too rapidly, I believe a few days' effort, by one thoroughly conversant with all the intricacies of infant feeding, should be made in an attempt to correct the symptoms produced by the stenosed pylorus. How long this effort is to be carried on can only be determined by the individual circumstances. One writer says the child must not go below six pounds, but six pounds weight for a six to ten weeks' baby is a much more grave affair than six pounds weight at one or two weeks, and a birth weight at four months is far worse than a pound or two below birth weight at one month. Sunken fontanelles are danger signals, as are also very concentrated urine and meconium like stools, etc.

A child just beginning to gain under a change in food must not be dismissed or forgotten, as these periods of improvement are frequent and usually short lived. They are illusionary and raise false hopes. My own experience has been that in a case where "watchful waiting" is decided upon, the "watching" must be even more constant and efficient than in the operated cases. A child maintaining a good nutrition even though vomiting a rather large amount of each feeding, may be watched and worked with for some time, but I beg of you do not neglect to have daily weighings and do not be satisfied with a too long period of stationary weight maintenance. Give the child

## HYPERPLASTIC PYLORIC STENOSIS

the benefit of surgical interference at a time when the surgeon is yet able to do justice to the patient and himself I believe that these border line cases should have both a physician and a surgeon in attendance as a check on each other

A differential diagnosis must be made from the vomiting of a simple gastric or gastro-intestinal disturbance, intestinal colic, other forms of obstruction and the various food injuries In one of my cases it is possible we had to deal with, and should have differentiated, a condition about which there is little written, I refer to rumination or merycism This child was about five and a half months old, had vomited since about six weeks old, so that when I saw it its weight was but little more than birth weight There were no constitutional disease stigmata, practically everything had been tried in the line of food preparations, many antispasmodics had been used without effect upon the regurgitation There was an absence, at the time Dr Lamb and I saw the child, of a gastric wave, but a dilated stomach was present, and we felt the absence of the wave was due to this atony of the gastric muscle With the long vomiting history it then seemed that a rapid exploration was justifiable This was done, but the pyloric ring was not sufficiently thickened to satisfactorily account for the symptoms, nor was other pathology found, nevertheless the Rammstadt operation was made, and for a while we thought the regurgitation was lessening Every effort was made to feed this child an acceptable and assimilable food, but part of the ingested food passed through the intestinal tract undigested, and part was continuously regurgitated The child apparently sucked on some of the regurgitated food and the nurses commented upon this latter condition The slow loss of weight continued until death occurred on the sixteenth day At post-mortem the operative field was in perfect condition and the pylorus easily patent to my index finger No adhesions or anomaly could be detected any place in the intestinal tract With my present knowledge I would not operate on a similar case, "hind sight" says that this was probably a case of infantile merycism or rumination, though at the time I did not know this occurred in infants. I have reported this case in full to prevent others from making a similar mistake This mistake has been made before, as reference in the literature associates the two conditions not infrequently (Strauch, *A M A J*, September 21, 1915, p 678)

There are certain complications connected with this work on pyloric hyperplasia in infants that are well worth further observation and warrant extremely watchful care upon the part of the physician in charge There has been forcibly brought to my attention, by two examples in personal experience, the fact that pyloric stenosis has associated with it an unduly high percentage of cases of thymus enlargement

My first case was rescued from what seems might have been a thymic death, by the prompt action of Dr W M Doughty who happened to be at Christ Hospital at the time of an acute dyspnoeic attack. It was the third day after a posterior no-loop gastrojejunostomy for well-defined pyloric obstruction that the infant rather suddenly was seized with dyspnoea, stridulous breathing, became cyanotic and gave every evidence of an alarming condition. I was out of the city that day, and the nurses sent a hurry call for help. Dr Doughty responded, picked the child up and hurried to the X-ray room where he snapped a picture and gave a treatment. The picture showed an enlarged thymus and the treatment was followed by a rapid amelioration of symptoms, so that by the next day the child was apparently no worse for its experience. The second case of this complication was in my last congenital pylorus stenosis case, operated January 4, 1917. Before operation we had commented upon the ashy color of the infant, and during the operation Dr L S Colter, who was administering the ether, remarked frequently concerning the labored breathing and the cyanosis. Physical examination of the chest by Dr Frank Lamb did not bring out a detectable widening of the mediastinum. The special nurse on the case was instructed to watch particularly the respiratory symptoms, after about ten days I ordered an X-ray picture of the chest so as not to overlook a possibly enlarged thymus, and that day the child manifested considerable dyspnoea and respiratory embarrassment. An X-ray picture by Dr Doughty showed a distinctly enlarged gland, and subsequent treatment has brought complete relief.

In talking to others I have found five cases, operated by five different men in Cincinnati, where sudden death followed successful operation for congenital pyloric stenosis. Two of these cases were proven to be thymus cases at subsequent post-mortem, in one a few days after the operation the thymus was nearly three times the normal size, and in the other, a few months after operation, the thymus was over three times normal size. The other three cases died suddenly with thymic symptoms but the thymic enlargement was not proven. Seven such cases, in the small circle of my observation and in a field so limited as congenital pyloric stenosis, are all out of proportion and there must be some relationship other than coincidence. To support this latter view the literature of congenital pyloric stenosis contains rather frequently such statements "These children are prone to sudden death" "Death occurs unexpectedly". So far I have not been able to find any explanation in the literature as to the cause of these deaths. One cannot refrain from asking what, if any, is the relationship between thymus enlargement and pyloric muscle hyperplasia?

A complication of less seriousness, but very annoying, is the

FIG 1

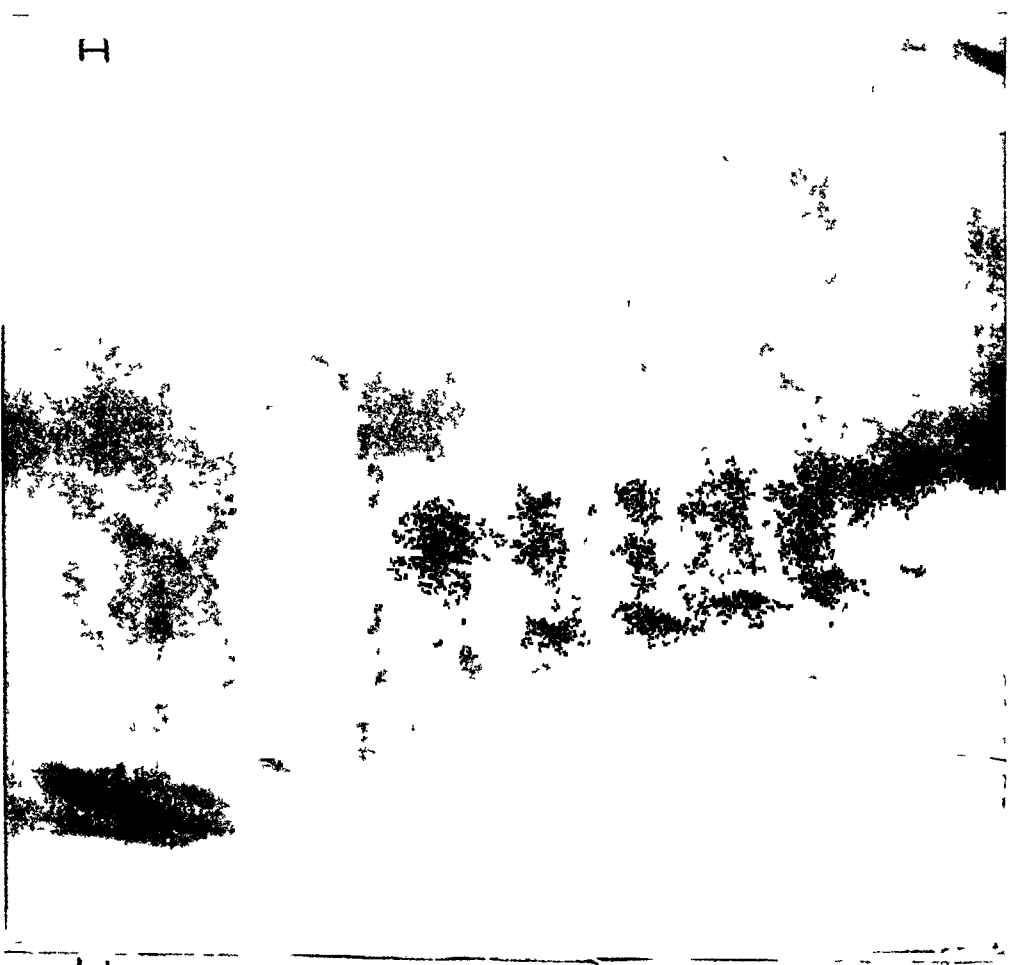
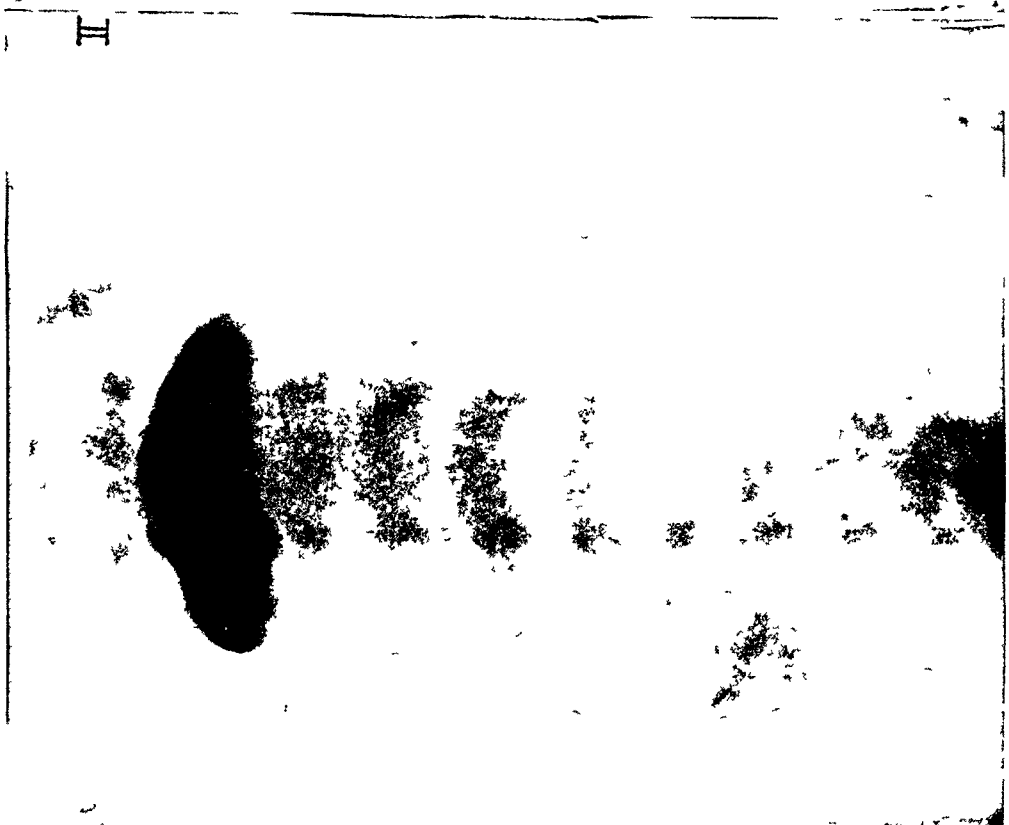


FIG 2



Figs 1 and 2—Baby D, forty days old. Note huge dilated stomach, three layers—bismuth, fluid, air. Poor risk, as stomach was atonic. Doubled weight two months after operation. Fig 2 was taken one hour after Fig 1. Vomited in interval. Almost complete stenosis.



FIG 3

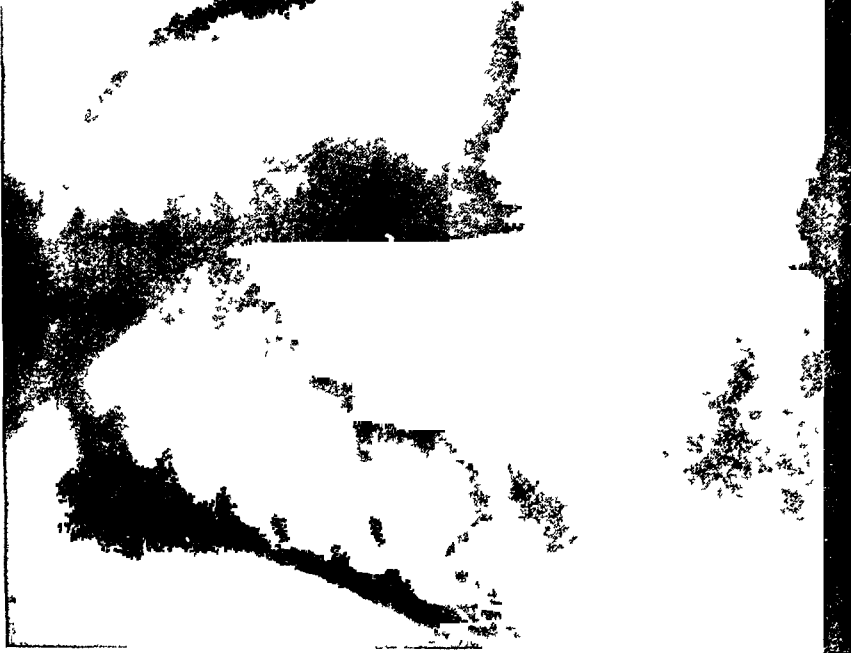
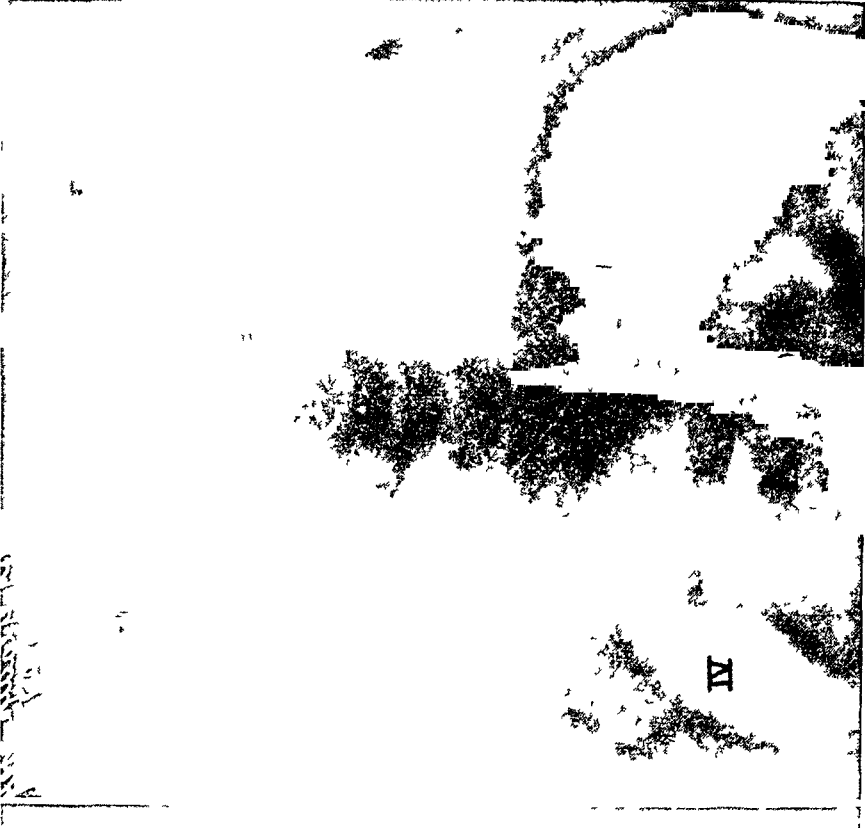


FIG 4



FIGS 3 and 4 —Baby M Second reported thymus case Note broad thymus shadow (Fig 3) as compared with normal shadow (Fig 4) two weeks later, after two treatments



FIG 5 —Baby T D , three months old Very marasmic Died without operation Note failure of flaccid stomach to contract on bismuth meal



danger of oozing from the skin wound during the first twenty-four hours post-operative. In one case this was alarming and necessitated local astringents and horse serum hypodermically. Remembrance that it takes but a few cubic centimetres loss of blood to throw the balance against these starved dehydrated babies, should make one adopt every precaution, and it is wiser to use a hæmostatic button-hole suture in the skin closure with a very small dressing of gauze to insure the prompt detection of bleeding. This tendency to bleed also shows itself at the pyloric incision in the Rammstadt operation. Considerable care is necessary to avoid vessels in this incision and every effort must be made to stop the oozing before the pylorus is dropped back into the abdomen. In dividing the circular muscle fibres of the pylorus great care must be used to avoid injury to or puncture of the mucous membrane on the duodenal side of the pylorus. The change from the thick pylorus to the very thin duodenum is so abrupt as to make this point the one dangerous place in the operation. In the case diagnosed rumination I made a very small puncture wound of the mucous membrane, but was able to close it perfectly, as previously shown in the post-mortem report.

Practically all my cases have shown a tendency to wound secretion and induration with redness of the wound beyond that which is usual in laparotomies. This secretion is sufficient to require daily dressing of the wound for two to fifteen days and alcohol (70 per cent) is best for this purpose. No wounds have suppurated and all have ultimately healed perfectly. I have attributed this tendency of the wounds to the inability of the delicate tissue to take care of the suture material.

In the first three cases operated upon I did a posterior-no-loop gastrojejunostomy with small clamps and suture. These three cases are well to-day and I had no reason for seeking another type of operation other than the feeling that the technical difficulties of a gastroenterostomy were sufficiently great, in a six to seven pound baby, to make it a very serious procedure. These disadvantages include a too great exposure of the abdominal contents with danger of unexpected evisceration, length of operation, increased shock, dangers from peritoneal soiling due to sutures tearing out, increased chance for bleeding, radical change of the anatomy of the gastro-intestinal tract, and forced delay in feeding by mouth in the already starved child. The Rammstadt pyloroplasty operation overcomes all these disadvantages, but in my cases there has been a tendency to spit up a mouthful or so of the feeding, for a few days to a couple of weeks, post-operative. The forced, explosive, projectile vomiting is immediately corrected but the tendency to slight regurgitation is much greater than in the more formidable operation where spitting up occurred but once or twice in each of the cases. This alarms no one except the

anxious mother, unless the mother is forewarned. Other symptoms, as pain, gastric wave, loss of weight, etc., are promptly relieved. One case, the daughter of a physician, continued to spit up as long as the child was in the hospital, during which time the mother's milk was carried in bottles from the home, as soon as the baby was taken home and received the nourishment direct from the breast all spitting up of food ceased immediately. Grulee, of Chicago, has called attention to this phenomenon and offers the suggestion that there may be some change in the chemistry of the milk through the action of light rays. Following the Rammstadt operation diluted food may be given as early as three hours after operation.

Since September, 1915, I have seen thirteen cases of congenital pyloric obstruction. In three of these further observation was advised, one died suddenly while we were waiting for the mother's permission to operate, and of the remaining nine, on three a gastro-jejunosomy was made, and on six the Rammstadt operation. All operative cases were at Christ Hospital. Eight of the nine operated cases had a very marked tumor formation at the pylorus that could not but produce a decided obstruction to the passage of food, the one exception I have described in full under the heading of rumination.

Of the thirteen cases, nine were first-born and eleven were males. One was the fourth, one the third, and two were second children. Practically every case started out as a breast fed case, but a number of the mothers were advised to stop the breast feeding. The cases for which we still had a good supply of breast milk after operation far outstripped the others in rapidity and smoothness of convalescence. I cannot speak too strongly against the too frequent advice to "allow the breast to dry up" that is given by some doctors. The breast should be kept functioning even though other foods are being experimented with temporarily. In one case where secretion had practically ceased there seemed to be some secretion redeveloped after several doses of pituitrin.

In reviewing my histories I find I have marked, under the heading of "gastric wave," six cases as being triple positive, four as double positive, one as positive, one questionably positive, and the negative one is the case of rumination.

Under "palpable tumor" I have six cases marked as positive, five as questionably positive, including the one case of rumination, two were negative and these have not been operated though one may probably come to operation.

The average of the onset was twelve days, with five of the cases giving a history of some vomiting from birth, the oldest child was about six and a half weeks at the onset of symptoms. The average age at operation was fifty-two and a half days, with one hundred and sixty-five days the age of the oldest (case of rumination), and seven-

## HYPERPLASTIC PYLORIC STENOSIS

teen days that of the youngest child. The average length of the period of symptoms of the operated cases was thirty-five days, with ninety-two days the greatest, and six the least. Seven of the nine operated cases lost an average of twenty-four ounces from the maximum weight, which is usually the birth weight, two cases gained ten and thirteen ounces before operation, but as these two cases were sixty-eight days and five and a half months old, respectively, this gain is relatively a great loss. These latter cases, long partially starved, are unusually poor risks. Of the three living cases not operated, one is apparently well several months after the last vomiting. One case is now a year old, weight  $18\frac{3}{4}$  pounds, but until six weeks ago had almost weekly attacks of vomiting lasting a day or so, one attack has occurred in the last six weeks. The third case, still under observation, eight weeks old, weighs fourteen ounces more than birth weight, it is vomiting daily after from two to all feedings, and has had gastric waves seen by Dr. Lamb, but on three visits I have failed to stimulate visible waves. The character of the vomiting and self-evident pain show there is some degree of obstruction to gastric drainage. This is the type of case where the best judgment is necessary to decide when to operate. It will probably be interesting to you to know these nine operated cases changed professional hands at an average of  $1\frac{3}{4}$  times before a diagnosis was made.

The average age of my eight living operated cases was seven and two-fifths months, at the time I last heard from them, and the average weight was seventeen and two-fifths pounds, or nearly one pound above the average given in Holt's book, this is in spite of the tremendous handicap of the first couple of months, and shows how very rapidly the gain is made if they have this opportunity given them. This work is the most satisfactory and pleasing work one can possibly imagine, even though the worries connected with it are quite acute for a few days. The surprised and intense pleasure of the parents when they see their first (usually) offspring begin to retain food, rest and sleep contentedly, pass digested milk stools, gain in weight, and in general lead normal baby lives, is most gratifying. Then, too, there is the real pleasure of saving a life that a few years ago might have been lost.

# GIANT DUODENUM\*

WITH REPORT OF A CASE IN A CHILD

BY WILLIAM A. DOWNES, M D  
OF NEW YORK

CHRONIC dilatation of the duodenum without demonstrable pathologic changes either in the intestinal wall or surrounding tissues is observed not infrequently. This condition may be present in patients suffering from stomach, gall-bladder or pancreatic disease, or may result mechanically from peritoneal bands, or from pressure at the terminal portion of the duodenum in cases of general enteroptosis. However, in many instances a satisfactory explanation is lacking. The distention may involve not only the first or second portions of the duodenum, but may extend throughout its entire length. The gut wall is not thickened and may even be thinner than normal. This form of chronic duodenal dilatation is without characteristic symptoms or physical signs. Rontgen examination may be of assistance in making the diagnosis, but the findings are not constant and for this reason cannot be depended upon.

Contrasted to the above group of cases is the so-called giant duodenum—similar in nature to the well-known megacolon of Hirschsprung. Very few of these cases are mentioned in the literature. Corwin<sup>1</sup> in reporting a case in 1915 quoted W J Mayo as stating, that he had observed only one. Most of the reported cases have been in young adults. I can find no recorded instance of the disease occurring in a child. This condition presents a definite pathology as shown by extreme hypertrophy of the muscular structure of the intestinal wall, the symptoms and physical signs are characteristic and the rontgenologic findings positive. It is usually referred to as of congenital origin based on the assumption that the defect is in the intestine. However, it is much more probable that the gut is normal at birth, and that the distention and hypertrophy result from constriction at some point, usually the duodenojejunal junction. This constriction may be due to a congenital anomaly in the nature of a mesenteric band or to abnormal fixation of the terminal duodenum. It may also result from pathologic conditions, such as enlarged mesenteric glands or inflammatory adhesions.

The following case of giant duodenum came under my care at the Babies' Hospital.

B W, male, aged four and one-half years. Admitted October 31, 1916, with a history of recurrent vomiting. Weight at birth 6 pounds—admission weight 29 pounds with clothes. Breast fed for five months. Vomiting almost from birth—at

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\* Read before The New York Surgical Society, April 11, 1917

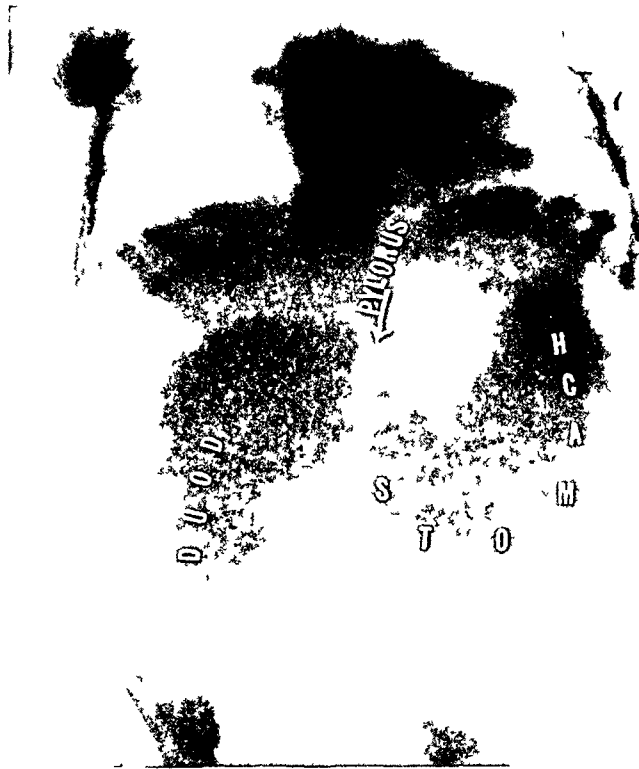


FIG 1 —Note size of duodenum as compared with the stomach



FIG 2 —Stomach almost empty, duodenum even larger than the first picture Note small amount of bismuth in jejunum



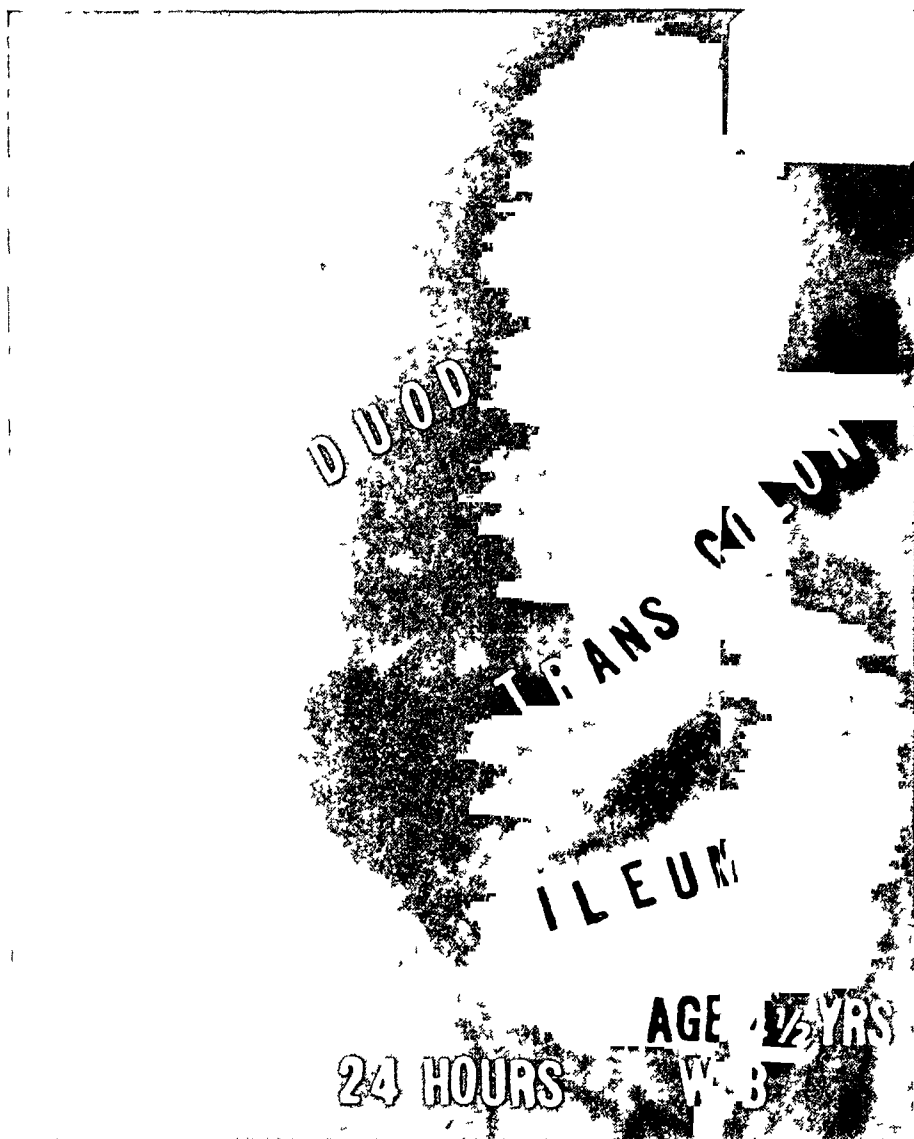


FIG 3 —Duodenal pouch still distinctly outlined

first very small quantities, later larger amounts. Periods of from one to two months without vomiting. As the feedings were changed from fluids to semisolids the vomiting attacks continued. Vomitus frequently contained food taken from one to three days before, always hungry, and could eat immediately after vomiting. At four months of age had a severe attack of diarrhoea with blood and mucus. Similar attacks about every two months. At eighteen months had an attack lasting three weeks, accompanied by high fever and extreme prostration. Last severe attack January, 1916. Marked constipation between diarrhoeal attacks. Stools foul smelling. Abdomen always distended, especially in epigastric region. Raised great deal of sour-smelling gas.

*Examination*.—Fairly well-developed, under-nourished child, very bright, color good, moderate distention. After taking 85 water marked peristaltic waves of unusual character were noted in upper abdomen. The movements of the stomach were not of a definite peristaltic character, traveling as do the ordinary cases of pyloric stenosis from left to right, but there was an irregular set of contractions visible sometimes near the cardiac and sometimes near the pyloric end of the stomach. In the region below the pylorus, to the right, there was a very definite peristaltic action—the waves passing from above downward and below upward, usually concentric in character. A large oval contracting mass could be felt in this region, and definite splashing sounds could easily be elicited. Percussion at this time gave a tympanitic note, although later on, when the pouch became filled with fluids, the note was flat. Lavage soon returned clear, to be followed later by bile-stained fluid with old food particles. No effort was made to distend the stomach or duodenum with air, as the X-ray had already given a clue to the diagnosis. Radiogram taken by Dr. R. D. Baker showed the following. Fifteen minutes after bismuth meal (Fig. 1) the stomach was seen to be in normal position and of about normal size. Just to the right of the stomach was shown a pouch, extending nearly in a vertical direction and fully the size of the stomach, which was apparently the dilated duodenum. In the second picture, taken two hours later (Fig. 2), the stomach had almost emptied itself, but the dilated duodenum remained about the same or was even larger, only a small amount of the bismuth had passed into the jejunum. Picture at twenty-four hours (Fig. 3) showed bismuth well into the colon, but the duodenal pouch could still be outlined distinctly. A study of these plates with the history and physical signs led to the diagnosis of partial obstruction of the duodenum, probably at the duodenojejunal junction, with saccular dilatation above. The patient was given daily lavage and small doses of atropine three times a day for one week.

*Operation* (November 6, 1916).—Posterior no-loop gastro-enterostomy and closure of pylorus by silk ligature; upper

right rectus incision Stomach appeared normal with possibly a slight thickening of the wall, pylorus normal, easily admitted tip of index finger Duodenum dilated to the size of the stomach Wall smooth and three to four times thicker than normal No diverticula observed No adhesions or peritoneal bands The distention involved the entire length of the duodenum, ending abruptly at the point where the gut passed under the superior mesenteric artery No effort was made to determine the nature of the stenosis or its cause The jejunum from its very beginning appeared normal in every way No distention or hypertrophy There were no adhesions in the region of the fossa of Treitz No enlarged mesenteric glands The usual posterior gastro-enterostomy was performed, double zero chromic catgut used throughout Complete division of the pylorus was planned as a part of the original operation, but the condition of the child would not permit the carrying out of this step, and we were forced to resort to occlusion by means of a heavy silk ligature Vomited moderately for twenty-four hours after operation, otherwise convalescence straightforward

Discharged November 23 On mixed diet at this time, eating three meals a day Condition very good No distention and no fulness could be felt in region of duodenum One week after discharge from hospital vomiting recurred—first in small quantities, but later in increasing amounts and at one time vomited as much as  $1\frac{1}{2}$  quarts Distention returned and the general condition of the child became much the same as it had been before operation Readmitted to the hospital December 6, almost in collapse, temperature subnormal and abdomen greatly distended Lavage brought away a large quantity of undigested food with immediate improvement in the general condition

Daily stomach washing and strict dieting failed to give more than temporary relief, the waves reappeared in the right upper quadrant, the temperature remained subnormal and the whole appearance of the child became distinctly worse It was quite apparent that the pylorus had opened up Since the improvement had been so marked for the first four weeks following temporary closure of the pylorus, complete division of this structure seemed to be indicated, and accordingly this was done on December 19 At this operation it was found that the ligature had cut partially through, and that there was free communication between the stomach and duodenum The child did well for the first forty-eight hours following the second operation, then began to complain of pain in the epigastric region and at the same time a slowly forming mass could be felt in the right upper quadrant This mass increased so that on the fourth day it occupied the entire right side of the abdomen Temperature rose to  $104^{\circ}$ , and it was thought that peritonitis had developed The distention in the right side was undoubtedly due to the fact that fluids and gas

were accumulating in the duodenum *via* the gastro-enterostomy opening, and it did not seem possible that the suture line could stand so great a strain. However, on the fifth day, after repeated enemata, gastric lavage and the use of pituitrin, the bowels began to move freely, large quantities of gas passed and the distention along with the mass disappeared. Convalescence from this time though slow was without incident. Discharged January 8, 1916.

For the first few weeks after returning home weight remained at a standstill, but more recently has begun to gain. Bowels move regularly, appetite good, and no return of vomiting attacks. Has had no distention nor have peristaltic waves been observed since he was discharged from the hospital.

*Discussion*—The history of this case has been given in rather extended detail for the purpose of bringing out the symptoms, physical signs and Rontgen ray findings of an unusual condition. Also with the view of trying to determine whether or not the correct operative procedure was adopted. The symptoms and physical signs of importance were periodic attacks of vomiting, diarrhoea alternating with constipation, epigastric distention, and a peculiar form of peristaltic waves situated to the right of the median line running from above downward and below upward. Belching of large quantities of sour-smelling gas, and the return from the lavage which would at first be clear, to be followed later by partly digested food—known to have been taken days before—indicated the presence of a pouch-like formation either in the stomach or duodenum. Rontgen examination showed the contour of a normal stomach and an enormously dilated pouch, occupying the usual position of the duodenum, which left little doubt as to the diagnosis. Exact location of obstruction was the only point undetermined before operation.

Surgery offers the only possible means of relief in this class of cases, and the choice of operation lies between gastro-enterostomy with or without closure of the pylorus and duodenojejuno-stomy. Believing that gastro-enterostomy with resection of the pylorus would prove satisfactory in our case, the question as to the advisability of uniting the duodenum directly to the jejunum did not receive sufficient consideration either before or during the operation. As the stenosis was not of an inflammatory nature and had always permitted a certain amount of food to pass, it seemed that there would be sufficient room for the escape of biliary and pancreatic secretions, and that if the pouched duodenum was placed at rest it would very soon contract to its normal size. That this theory was more or less correct is borne out by the fact that until the ligature encircling the pylorus cut through the symptoms were relieved, and that since the pylorus was divided the child's condition has been satisfactory—barring the single attack of distention coming on

forty-eight hours after the operation I believe there would have been less likelihood of the duodenum giving trouble in the future, if instead of using the no-loop method, the anastomosis had been made about 15 inches from the duodenojejunal junction and enteros-anastomosis added. Gastro-enterostomy has been performed in many cases of chronic dilatation of the duodenum—very few of which were of the giant type—with only fair results. Improper selection of cases and failure to permanently exclude the pylorus may explain in part the unsatisfactory outcome.

Duodenojejunosomy is the logical operation for the relief of obstruction at the terminal portion of the duodenum. This operation was originally suggested by Bloodgood,<sup>2</sup> but the credit for first performing it belongs to A. L. Stavelly.<sup>3</sup> In a personal communication of recent date Dr. Stavelly<sup>4</sup> says that his patient, operated upon in 1908, was perfectly well when last heard from two years ago. I can find the record of only one other case operated on by this method, and that was by Dr. E. H. Beckman, of the Mayo Clinic,<sup>5</sup> in 1914. On opening the abdomen in this case a cystic tumor ten inches in diameter presented. The colon with the posterior layer of peritoneum was pushed forward. Examination disclosed an enormous duodenum extending from within two inches of the pylorus to the jejunum. The jejunum was somewhat dilated for a distance of three feet. Two fingers could be passed underneath the mesenteric vessels so that mechanical obstruction did not appear to be a factor. An entero-anastomosis was made between the distended duodenum and the jejunum, fourteen inches from its origin. There was a great deal of vomiting after the operation, the patient became very weak, and died on the sixth day. Autopsy showed a necrotic condition of a considerable portion of the jejunum which suggested that a thrombosis of some of the mesenteric vessels might have taken place. Some ten other cases have been observed at this clinic in which a distinct dilatation of the duodenum was found at operation, but this was the only one in which an operation was directly performed.

It is entirely too soon to pass final judgment on the outcome in our case. The end result may be all that could be desired, but after careful consideration of the subject from all points of view, I believe that duodenojejunosomy best meets the indications in the giant type of duodenal dilatation, and should have been adopted in the case herewith reported.

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# MEGACOLON MEGASIGMOID

HIRSCHSPRUNG'S DISEASE

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HIRSCHSPRUNG (1886) described a condition of "congenital high-grade dilatation of the colon, with thickening of all its tunics, especially the tunica muscularis, with retention of large quantities of fecal matter" The great dilatation may occupy the whole length of the colon, from the cæcum to the upper part of the rectum One case was reported in which the dilated intestine and its contents weighed forty-seven pounds

It is claimed by some that this condition is often acquired, due to the kinking of a long sigmoid loop which sinks low into the pelvis; patients with megasigmoid are always in danger of ileus The congenital form is most frequent, and is seen very often in young boys, the sigmoid being most often involved The usual symptoms are enlarged upper abdomen—the xiphoid-umbilical measurement is very much increased Emaciation occurs from faulty nutrition and the whole outlines of the colon can be seen through the walls of the abdomen Constipation is always most obstinate, and as it advances, there occur distention pains, which are relieved by repeated purgation and artificial emptying of the colon by copious enemata

The treatment usually advised consists of frequent purgation, making an artificial anus and "short circuiting" the colon, also colectomy The prognosis of this condition is grave in most cases with or without operation, but more recently the operative statistics have improved considerably A case of this condition of the colon has recently been under my care, as follows

Joe S, aged twenty-two years, male, white, laborer Family history good Had malaria when eighteen years of age As a child was always having trouble with his abdomen—suffering pain more or less, and constipated all the time During the past two years, he has had serious obstipation and great abdominal distention, especially in the upper abdomen (see Fig 1) Strong purgatives and repeated copious stimulating enemata often failed to empty the colon X-ray examination after ingestion of 4 ounces of barium sulphate was negative The patient had no nausea or vomiting and did not suffer much pain There was great distress from distention of the abdomen, this was aggravated by drinks and ingestion of food Because of the frequent attacks and the long disability therefrom, it was decided that an exploratory incision be made

A long median incision was made, exposing all the intestines, the whole of the colon was moderately dilated and the sigmoid was sacculated its whole length, the sac was the shape of the stomach and measured 21 inches long and 18 inches in circumference, and was about half filled with fecal matter (Fig 2) The walls of the sac were very thick and white in appearance Excision of the whole sac or dilated segment was done between two clamps, and end-to-end anastomosis by suture made The patient made an uninterrupted recovery, without any febrile disturbance His condition at present, now two months since the operation, is good, his bowels move twice daily without purgatives, his weight has increased 15 pounds and there is no distention of the abdomen His general condition is fine—his ruddy color has returned, his appetite and digestion are normal

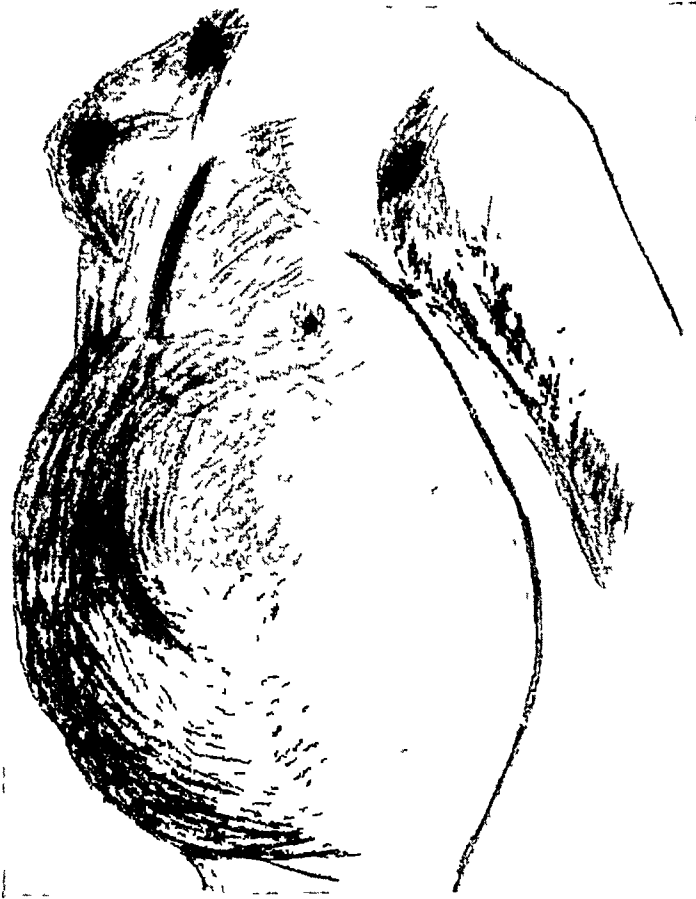


FIG 1 —Megacolon (Hirschsprung)

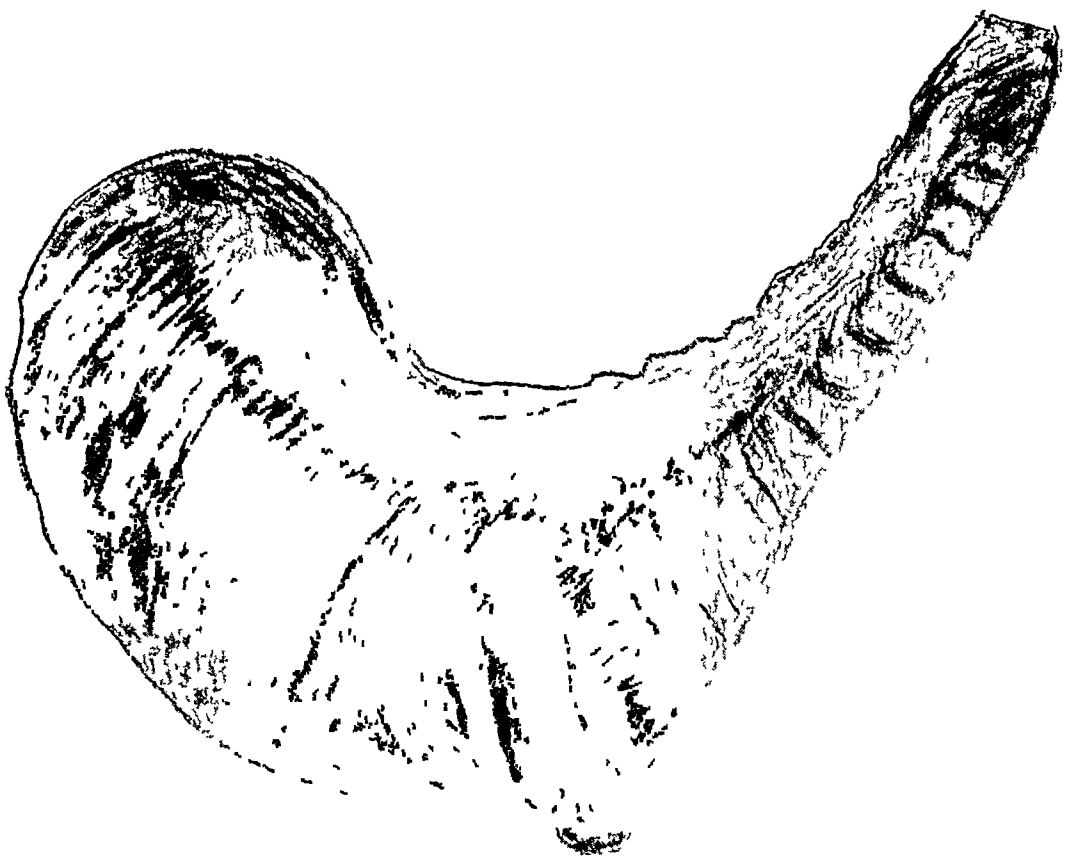


FIG 2 —Sigmoid (Hirschsprung)





# THE SAFE ELIMINATION OF THE COLON FOR THE RELIEF OF UNCONTROLLABLE INTESTINAL STASIS<sup>1</sup>

BY ALBERT J OCHSNER, M D

OF CHICAGO

AFTER eliminating the very large number of patients suffering from intestinal stasis who are primarily neurotics and suffer from intestinal stasis only secondarily, who are practically never benefited by surgical treatment, and the still larger number of cases suffering from intestinal stasis who can be permanently relieved from this condition by exercise, hygiene, dietetic and carefully planned, long-continued medical treatment, there still remains a very small class of cases, in our experience comprising less than 5 per cent of all cases suffering from intestinal stasis, which constitute a third and distinct class whose members are not primarily neurotics and who are in so intractable a condition of intestinal stasis that they cannot obtain relief from non-surgical measures

The members of the first class described above should not be subjected to surgical treatment because this treatment does them no good. Neither should this treatment be employed in members of the second class because they do not need it.

Surgical treatment should, consequently, be limited to the third class of cases described above, and these should be given the benefits of surgical treatment, provided this does not involve too much danger to life and insures permanent relief without troublesome complications. Most of the early methods employed failed in at least one of these respects, although the chief fault lay in the fact that these methods were applied very largely to patients belonging to groups one and two in the above classification.

The method first advocated by Lane,<sup>1</sup> consisting of a simple ileocolostomy, was especially unsatisfactory because of the tendency of fecal material backing up in the colon in a proximal direction from the enterostomy opening, filling the descending, the transverse, and even the ascending colon and sometimes the cæcum.

A partial closure of the sigmoid above the enterostomy opening frequently failed to relieve the condition. The plan suggested by W J Mayo<sup>2</sup> of excising the cæcum and ascending colon and preserving the descending colon proved satisfactory only in a small number of cases. The plan of excising the entire colon down to the sigmoid flexure, or including a portion of this, advocated by Lane and many of his followers in severe cases, increased the danger of the operation enormously, except in the hands of surgeons of very great skill. It also deprived the patient of the omentum. It would seem that the loss of this important organ should not be underestimated. In order to overcome this objection we employed a method,

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\* Read before the American Surgical Association, May 31, 1917

with great satisfaction in a number of cases, in which we severed the ileum 20 cm from its entrance into the cæcum, implanted the proximal end into the side of the lower end of the sigmoid flexure and brought out the distal end of the ileum through a small McBurney incision directly in front of the cæcum<sup>3</sup> Through this opening the colon was carefully flushed, at first daily and later less frequently This operation was fully as safe as the simple ileocolostomy, and had the advantage of enabling the patient absolutely to prevent the accumulation and stasis of fæces in the colon

In cases in which the tendency for the accumulation of fæces seemed extreme, however, we have, during the past two years, in two cases, made use of an additional step which was suggested to me by Dr William J Gillette, of Toledo, Ohio, and which seems to contain more features than any one of the other methods we have employed The illustration clearly shows all of the features of this operation

The ileum is severed at the point which makes the anastomosis of its proximal end to the sigmoid flexure of the colon most convenient The distal end is then carried out through a button-hole in the abdominal wall immediately in front of the cæcum, opposite McBurney's point, the fibres of the transversalis, internal oblique, and external oblique abdominal muscles being separated without being cut, in order that they may form a kind of sphincter to close the open end of the protruding intestine, which is held in position by means of a few fine silk sutures

The sigmoid flexure of the colon is then severed at a point leaving the distal end in the best condition to make an anastomosis with the proximal end of the ileum

In case an end-to-end anastomosis is made it is important to turn the two ends in such a position as to prevent having the mesentery of the ileum opposite that of the sigmoid, because of the danger of leakage at that point

An end-to-side anastomosis of the ileum into the sigmoid is very satisfactory In case both intestinal ends are closed in order to make a side-to-side anastomosis it is important to make the opening in the ileum near its distal end and to prevent the forming of a pouch or diverticulum beyond this point, as has been pointed out by N M Percy,<sup>4</sup> by attaching the very end of the stump of the ileum to the side of the sigmoid

A fairly soft rubber tube 1 cm in diameter should be carried up through the rectum and sigmoid beyond the anastomosis opening for a distance of 10 cm into the ileum, as recommended by Lane, in order that there may be no accumulation of gas in the ileum proximal to the anastomosis opening, as shown in the illustration, and in order that normal salt solution may be introduced directly after completing the operation by means of the Murphy drip The sphincter and muscle should be dilated very gently, but very thoroughly in order to increase the comfort of the patient during convalescence

The proximal end of the sigmoid flexure of the colon is then passed through an opening in the abdominal wall exactly opposite the opening on the

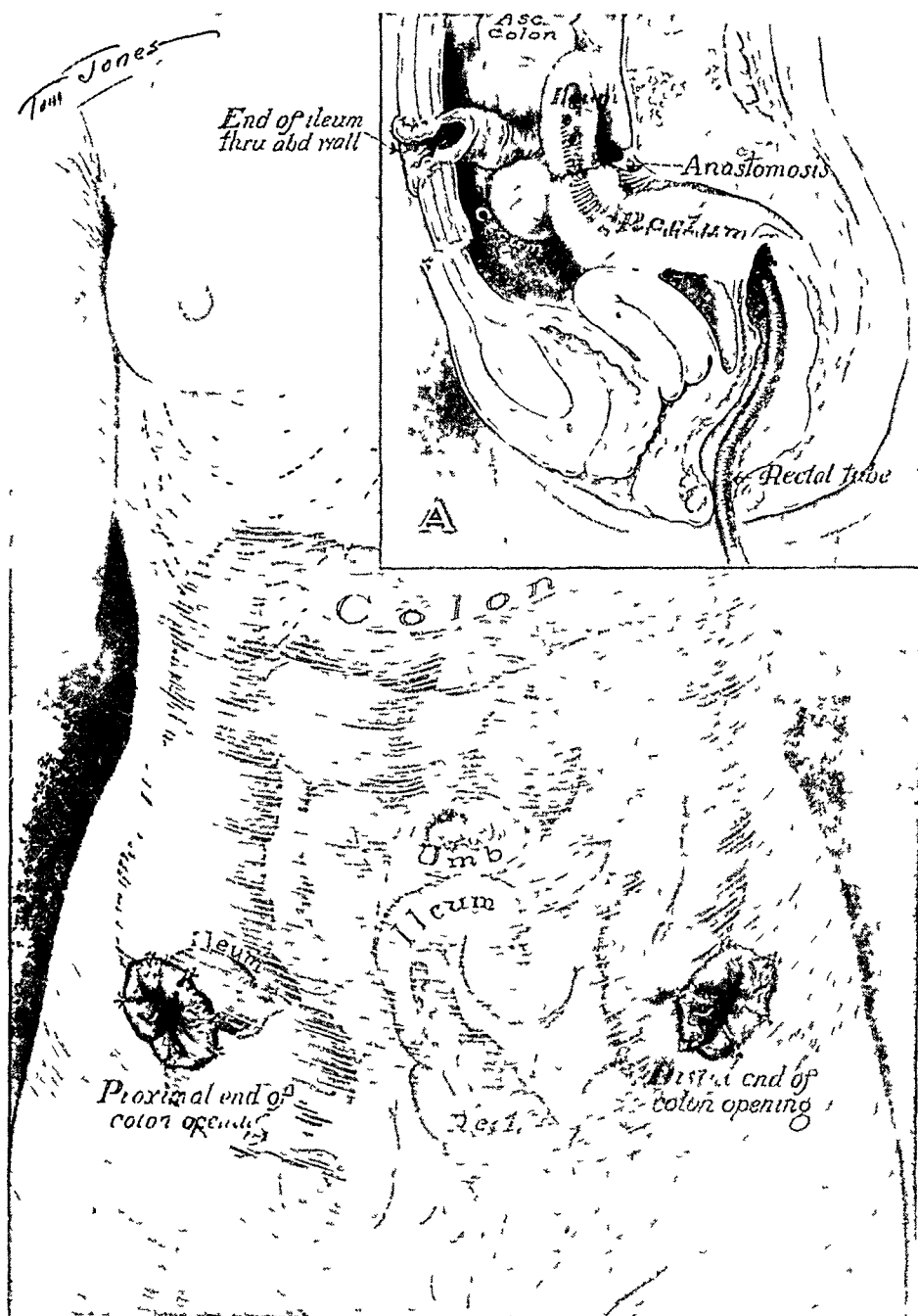


FIG 1



## ELIMINATION OF THE COLON

right side, through which the distal end of the ileum was passed during the first part of the operation. The end is permitted to project for a distance of 1 cm., and is fastened in place by means of a few fine silk sutures. This leaves the ascending, transverse, and descending colon and the omentum in their normal relations, able to protect the other intra-abdominal structures by their presence, while they are entirely eliminated so far as they can have any influence upon the causation of uncontrollable intestinal stasis. The slight amount of mucus which may accumulate in the colon can be washed out readily by inserting the nozzle of a syringe into the distal end of the ileum projecting through the abdominal wall. The condition causes the patient practically no annoyance, and is not offensive to himself or to others.

Since we have employed this method I have been anxious to try it in a case of Hirschsprung's disease, but so far I have not had an opportunity. It would surely reduce the danger of this operation in which the mortality, according to Picqué,<sup>5</sup> amounts to nearly 40 per cent.

The total number of cases in which surgical interference for the relief of intestinal stasis is indicated is so small that we have not had an opportunity to use this method in a sufficiently large number to justify conclusions, but it seems to possess a sufficient number of valuable qualities to make the method worthy of consideration.

The principle involved in this operation is, of course, the same that has been constantly in use in many operations upon the colon. A. E. Rockey<sup>6</sup> suggested appendicostomy in connection with Lane's operation for the same purpose.

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# IDIOPATHIC CHOLEDOCHUS CYST

WITH REPORT OF A CASE CURED BY CHOLEDOCHODUODENOSTOMY

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IN consideration of the rare nature of the disease and hoping to cast light upon its interesting pathogenesis, I should like to give an account of a case of severe cystic dilatation of the ductus choledochus, or, as it is designated in literature, idiopathic choledochus cyst, which was operated on by me last year

The case is that of a ten-year-old girl, C T, who was received into the county hospital of Lidköping on May 15, 1916

*Remarks*—No case of malformation in the family, no case of gall-stone, but, on the other hand, several cases of tuberculosis. The patient had whooping-cough and measles when two years old, and scarlatina in 1915, since which she has been delicate and weakly

According to the statement of the mother, the patient ever since the age of three has had about once each year an attack of abdominal pains, sometimes accompanied by vomiting, usually lasting one or two days, during which time she was obliged to keep to her bed. Jaundice never showed itself during these attacks

For three weeks before admission to the hospital the patient has occasionally had pains in the right side, but not so severe as to prevent her going to school. Three days ago, on the evening of May 12, the patient became ill with rather severe pains in the right side of the abdomen, repeated attacks of vomiting, but no shivering. The pains went through to the back, and were especially severe during deep respiration, but were somewhat alleviated when the patient assumed a half-sitting position. The following day, May 13, the patient felt better, the pains having diminished considerably. On May 14 the pains again became more severe with vomiting several times during the course of the day. The physician, who was called in, found there was fever and prescribed medicine. As the pains continued the following day, the patient was brought to the hospital. During her illness the patient has had normal stools on May 13 and May 15

*Present Condition* (May 15, 1916)—The patient is of slight build, rather thin, the general condition somewhat depressed, complexion pale without icterus, the scleræ show, however, a slight icteric tinge. Temperature 38.1, pulse 100. Urine clear, dark-green, containing gall-pigments and a trace of albumen

Heart and lungs, nothing to be remarked upon

The abdomen, as a whole, sunken. In the right upper part of the abdomen, about in the middle, a slight protuberance appears

in the wall of the abdomen about as large as half-a-crown. To palpation the above-named part corresponded to a tender resistance of about the size of a fist, oblong in form, with the long axis vertical, reaching downwards to the region of the umbilicus, and upwards to a finger's breadth below the costal margin, with a breadth from side to side of about 7 cm., lying in its greater part behind the right muscularis rectus, but protruding somewhat outside its outer edge. The tumor has a smooth surface and appears to be of rather firm consistency, but this is difficult to determine on account of the extreme tenderness. The tumor shows no respiratory mobility, does not permit displacement either from side to side or from above downwards, it does not give the impression of engaging the abdominal wall, nor does it appear to have any connection upwards with the liver, which as well as the gall-bladder is not palpable. The percussion tones over the tumor are somewhat shortened.

The patient had been sent in for supposed appendicitis. The palpable tumor might, if it had been situated somewhat further laterally, possibly be supposed to be caused by a retrocæcal abscess from an appendix, either unusually long, or situated abnormally high up, but the existing high and medial position seemed to put appendicitis quite out of the question, nor could the tumor be localized to any special organ as its origin. The preceding attacks of pain, as well as the existing slight icterus, might point to a cholelithiasis, although this disease is very rare in childhood, and the resistance could be explained as a *hydrops vesicæ fellæ*. The definite limit of the tumor upwards, without any connection with the liver, was against the theory of dilatation of the gall-bladder, further, its low degree of mobility and, in some measure, its form also. Opposed to the theory of the kidney as point of origin was the elevated and medial position of the tumor, as well as the absence of swelling in the flank. A cyst of the pancreas could scarcely be supposed, as they are very seldom lying so decidedly to the right of the medial line. It was not possible, therefore, to make a positive diagnosis, but it seemed to me quite evident that operative treatment was necessary.

An operation was performed the same evening under ether anæsthetic. A 10 cm long vertical incision was made through the middle of the right rectus muscle from the costal margin to the level of the umbilicus, somewhat curved upwards towards the middle line. In the cavity of the abdomen an inconsiderable quantity of clear fluid. Nothing of note as regards appendix. The gall-bladder free and mobile, of normal size, with somewhat hyperæmic serosa. No stones to be felt. Below the gall-bladder lies the tumor which had been perceptible to the touch, in a retro-peritoneal position, covered on its outer part by the transverse colon and the hepatic flexure and medially by the duodenum. It is of tense elastic consistency, in position and form corresponding in some degree to an enlarged kidney, so that my first thought was that it was a case of hydronephrosis. When better space had been



gained by a 5 cm long transverse incision outwards from the middle of the abdominal cut, the peritoneum was divided laterally of the ascending colon and flexure which were pushed towards the middle and the tumor, evidently of a cystic nature, was exposed, by blunt dissection, first on its front side, where, however, its connection especially medially with the peritoneum was very intimate, in addition to this the difficulty of detaching it was increased by a rich development of veins. Downwards it was easy to get round the rounded lower pole of the tumor, as well as to pass upwards on its posterior side. It is found then that no connection exists with the kidney, which lies quite normal and free behind the tumor. The opinion is now in favor of puncturing the tumor, and while waiting till the puncture syringe is boiled, the tumor is raised upwards in order to examine more closely from behind its medial connection, especially with the pancreas, which, however, shows nothing abnormal in palpation. During these manipulations, the remarkably thin walls of the cyst burst and discharge its contents—dark-colored clear bile. This is absorbed in gauze, and amounts to about 200 c c. The opening is widened upwards with scissors, so that the inside can be examined. The inside is pale, smooth, and of an equal surface with no perceptible alteration in the walls. No concrement can be discovered. It is evident that the sac consists of the highly cystically dilated choledochus, on account of its considerable depth it is impossible to see from the inside its connection with the upper gall-passages. When all the bile has been dried out of the sac, however, one could plainly perceive how the contents of the gall-bladder, on compression, emptied itself into the upper part of the sac. On examination of the continuation of the cyst downwards no continuous passage from the inside of the cyst could be discovered. After some searching, however, a small lumen was found, immediately to the left of the lower pole of the cyst, and this was found to belong to the upper end of the ductus choledochus lying behind the duodenum. An ordinary probe, inserted into this passage, went direct into the duodenum, without meeting any hindrance. The passage is 3 to 4 cm in length and possibly somewhat narrower than a normal choledochus. Evidently the rupture of the cyst had occurred just at the junction between the cyst and the lower part of the choledochus. With a few catgut sutures the upper end of the stump is implanted in the cyst in its original position. As the position of the incision on the posterior side of the cyst was not suitable for anastomosis, it was sewed together with 2 rows of interrupted catgut sutures, after which an anastomotic opening 1.5 cm long was made between the forward part of the cyst and the front side of the duodenum in the upper part of the pars descendens. The sutures were made in two rows, the outer one interrupted, the inner one continuous round about through the entire wall, both of catgut. The part where the choledochoduodenostomy was made as well as the suture line on the posterior side of the cyst and the part where the lower choledochus stump was

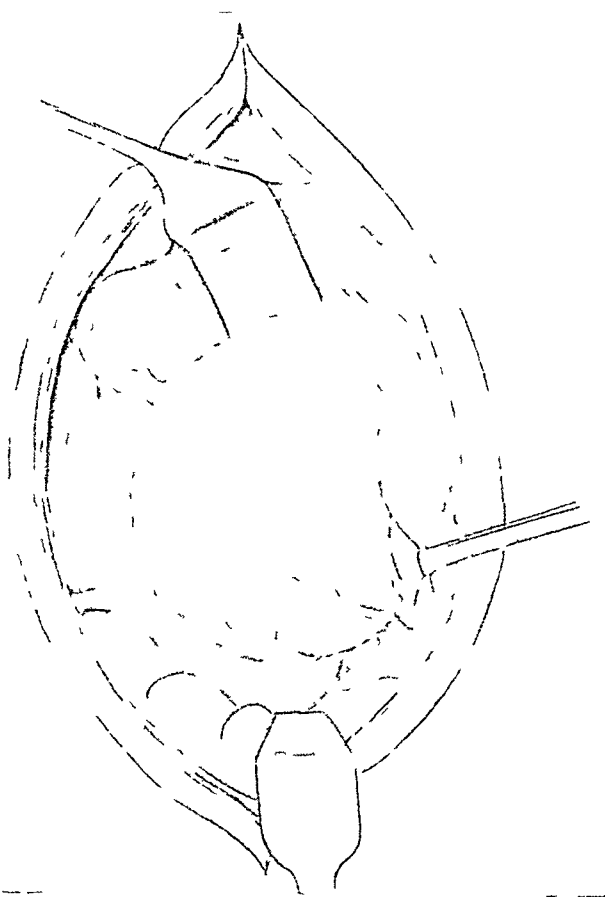


FIG 1 —Cystic dilatation of the ductus choledochus



implanted were wrapped round with a wisp of the omentum. A small rubber tube was inserted against the outer part of the cyst, at a little distance from the place of the sutures, and was led out through the lateral angle of the transverse incision. The abdominal wound was then sewed up.

The patient was considerably exhausted after the operation, the pulse was feeble and extremely rapid, she revived quickly, however, after stimulants. Two days after the operation nothing could any longer be discerned of the above-mentioned trace of icterus in the scleræ, or the gall-pigment in the urine. During the first week after the operation there was a rising in the patient's temperature, this, however, went down afterwards. On the seventh day the drain-tube was removed, on the eighth the stitches. Healing by first intention took place. On May 29 the patient was allowed to be up. Twice, on June 4 and June 7, occurred an evening rise of temperature to  $40.3^{\circ}$  and  $39.2^{\circ}$  respectively, with vomiting, but no other symptoms. On both these occasions the temperature was normal the following day. On June 10 the patient was discharged, healed and well.

It appears from the observations made at the operation (1) That the cyst (see accompanying drawing, Fig 1) was developed from the middle and upper part of the choledochus, (2) that the lowest portion of the choledochus, 3 to 4 cm in length, was not engaged in the dilatation, (3) that the above-mentioned part of the gall-passage, representing the communication between the cyst and the duodenum, did not show obstruction, and (4) that none of the otherwise usual obstacles to the passage of bile into the choledochus, in the form of stone, tumor, stricture, or pancreatitis, were found to exist. These circumstances exclude the presumption that this was a retention cyst in the ordinary sense, the case must be explained as one of idiopathic dilatation, a so-called real choledochus cyst, corresponding in all its details with all others of analogous type.

Previous to the operation this disease was unknown to me, and I was thereby led to an examination of the literature on the subject, the result of which seems to cast light upon the disease in question.

When Langenbuch in 1897 published his great work on the surgery of the gall-passages, he only knew of one case, that of Konitzky in 1888. In 1909 Ebner gave a summary of 11 new cases, described by Douglas, Edgeworth, Seyffert, Heid, Russell, Nicolaysen, Rostowzew, Dreesmann, Broca and Bakes, as well as a case of his own, operated on by Lexer. Schloessmann in 1911 reports 4 more cases—Wettwer's, Arnold's, Weiss's and one operated on by Sprengel. From Japan, in the following year, Mayesima gave a new observation of the disease. Kehr, in his last great work, *Neue Deutsche Chirurgie*, 1913, mentions 2 more cases, Letulle's and Goldammer's, and finally, 1916, Seeliger in a summary of the preceding cases, reports still another new case which he observed in 1913. Besides these cases, 20 in all, I have been able to

discover no less than 14 others, reported by Arnison, Butters, Twain, Ebner, Sternberg, Clairmont, Brun-Hartmann, Ashby, Kolb, Lavenson, Hildebrand, Ipsen, Smit and Heiliger. The sum total therefore of known cases, my own included, would be thirty-five. Common to all these cases is the circumstance that the disease could not be diagnosed clinically, in most of the cases, not even at the operation. For this reason and on account of an irrational method of operation most cases have terminated fatally, only a few having been restored to health by the operation. Among the latter I find only one case, that of Bakes, in which, as in the case operated on by me, an anastomosis was made primarily between the cyst and the intestine.

The idiopathic choledochus cyst, says Konjetzny, who has closely investigated the disease from the pathological anatomical point of view, is dependent upon a congenital anomaly in the course of the common duct. It differs distinctly from the not uncommon dilatations of the choledochus, which appears as a secondary circumstance in previous diseases of the gall-passage or pancreas as a result of the purely mechanical obstacles these diseases produce. The dilatation of the gall-passage in question includes, as a rule, the gall-duct in its entirety, converting it into a uniform cylindrical tube, retaining its original form, and never—even when of year-long standing—exceeding a certain degree of dilatation, corresponding about to the thickness of the small intestine—while the circumstances in the case of a choledochus cyst are quite different. It is here a question of what one might call independent primary enlargement of the common duct, only engaging its upper and middle portion, with free passage of its lower undilated part, forming a spherical or ovoid sac-like enlargement, a sort of “biliary cloaca” (Letulle), generally of very considerable size. Thus, in most cases, the dimension of the cyst has been about that of a child’s or a man’s head, in some instances, the quantity of fluid it has been capable of containing was as much as 4 or 5 litres. In my case the cyst was remarkably small, in comparison to the other cases. I estimated it as about the size of a fist, a volume which seems to be rather exceptional. The position of the cyst is below the liver, usually lying closely pressed against its lower surface. Sometimes, as in my case, when it had not advanced so far in its size, it lies a little below the liver. It often extends over the middle line, and goes backwards towards the spinal column, more or less further downwards, in not a few cases as far as the pelvis. It generally adheres firmly to the surroundings. The duodenum is forced more or less medially, to a degree corresponding to the size of the cyst. In one case, Seeliger’s, it was pressed quite flat against the front cyst wall, the stomach is pushed over to the left, and not seldom turned on edge with the great curvature forward. The right part of the transverse colon and the hepatic flexure are pushed to the left and downwards. The upper part of the gall system, including the gall-bladder, shows

either no dilatation or a very inconsiderable one in proportion to the choledochus. The liver, in the far advanced cases, has, when enlarged, exhibited the appearance of a biliary cirrhosis. As already mentioned, the lower, more fixed portion of the choledochus, lying behind the duodenum, is never affected by dilatation, and long retains its normal calibre. For the explanation of the manner of origin of the cysts, the minute examination of the condition of this part of the choledochus has been of great importance. It has been found several times that the end portion has undergone a development deviating from the normal, with a more or less oblique opening into the intestine in a direction from left to right, or from the front backwards, instead of the normal direction from right to left. A more or less marked kink has been thus produced, and this has been explained as an obstruction of the passage of congenital origin, causing the dilatation of the passage lying above. In my case, no such abnormal insertion in the duodenum could be found, and besides, it is difficult to think that this alone could be the real cause of the dilatation, when in all cases, signs of difficulty in evacuation have been existent only for a relatively short time, while the choledochus, to judge from the reports of the illnesses, has performed its function normally for years previously. Another circumstance which might be of greater significance is that in most of the operated cases a more or less sharp transition has been found to exist between the cyst itself and the upper part of the end portion. From the fact that the enlargement took place to the right and downwards, the developed diverticulum has been pressed with its left wall against the fixed end portion of the choledochus, compressing the latter, so that on cutting open the cyst, it actually looked as if this part of the choledochus lay like a fine canal in the medial cyst wall itself. Inside the sac, it had the appearance of a valviform duplication of the wall, and this valve has during life acted as a ventile with intermittent action. This circumstance would be, therefore, to a certain degree, analogous with hydronephrosis, produced by an obliquely inserting ureter or with a kink in the cystic duct, with transformed gall-bladder the so-called cholecystosis remittent. In the case operated on by me the existence of such a fold could unfortunately not be ascertained in consequence of the rupture of the tumor which occurred just at the point in question, but in view of the fact that the dilatation took place so far down that the lower pole of the cyst lay below the *pars horizontalis inferior duodeni*, consequently below the place of entry of the common duct into the intestine, I should consider it most probable that such was the case. The mechanism of the emptying of the cyst would then be as follows. With a certain fulness of the sac the fold is pressed close to the opposite wall, rendering emptying for the time impossible, by a continuous supply of bile from the liver, however, the pressure inside the sac is continuously increased, the cyst wall expands more and more, the effect of which will be that the spur-like fold of the mucous

membrane at the place of the kink is gradually pressed somewhat to the side, leaving a portion of the lumen free, and permitting the discharge of a quantity of bile into the duodenum. The pressure now relaxes again somewhat in the sac, and the wall contracts and forms a valve again, this hinders a further discharge and prevents the cyst from becoming completely empty. In many cases which have been sufficiently long under observation (Rostowzew's, Heid's, Wettwer's, Smit's) the working of this intermittent valve-mechanism has been clinically observed, showing itself in a peculiar and striking increase and diminution of the tumor with respectively increased and reduced tension or consistency and tenderness of the same, and it has in reality given the clinical picture of the disease a very characteristic feature. It may be mentioned in parenthesis that, in some cases, a similar valve or fold formation has been found, not only at the junction of the cyst with the end portion of the choledochus, but also farther up at its union with the cysticus and even with the hepaticus.

The above-described valve formation gives a sufficient explanation of the question, why the fully formed cyst cannot empty itself, and why it undergoes an ever-increasing enlargement of volume. But it is impossible to suppose that the valve can be developed until a part of the duct has been widened into a sac-like cavity and the existence of the valve is therefore not sufficient to explain what causes the first enlargement. Many hypotheses have been put forward for the explanation of this primary dilatation, which later leads to valve-formation and ventile obstruction. It has been supposed that there exists congenital weakness of the wall, with defective development of the elastic and muscular elements, a sort of atony, as predisposing circumstance, and, as immediate cause, a catarrhal mucous swelling, a stone, or spasmodic contraction of the choledochus sphincter. Further, Dreesmann has suggested the idea of a congenital primary dilatation of the passage. Kehr also mentions this, but says at the same time that proof of this possibility is, up to the present, absent from literature. It seems to me, however, that such proof really does exist, although not mentioned in any of the accounts published of operatively treated choledochus cysts, not even in Seeliger's of the last year. It is to be found related by Heiliger in 1910 in a dissertation from the Women's Hospital in Giessen. In postmortem examination of an almost mature male foetus, he happened to find, besides a diaphragmatic hernia (containing stomach, spleen and small intestine) also an alteration in the choledochus in the form of a 3 cm wide,  $2\frac{1}{2}$  cm long, tense, cyst-like distention of the same. He says, "through this sac-like distention of the choledochus, exclusively confined to its distal portion, which, in relation to the normal, must be regarded as a monstrous enlargement, and which only in a slight degree passes into the orifice of the hepatic and cystic ducts, the proximal end of the choledochus, which had its course in the wall of the choledochus sac, was compressed to such a degree that it was

only after some trouble and by means of a fine bristle that it was possible to probe this part. It must, however, be supposed that sufficient bile had come out into the intestine, for the intestinal contents were normally bile-colored, and there was not a single sign of bile stagnation, nor any icteric coloring of the tissues."

This observation of Heiliger's seems to me to give indisputable proof that the choledochus cyst itself can exist already formed at birth, that it can be really congenital. But from the fact of its existing from birth it does not necessarily follow that it should show immediate symptoms. On the contrary, all observations seem to indicate that it is in the beginning absolutely latent to its owner. This period of latency then, as appears from the accounts of the disease, can evidently, in different cases, vary very considerably, and as the cyst evidently has a marked tendency to develop continuously in size, it seems to be the natural conclusion that what determines the point of time when the first symptoms of the disease begin is the size of the fetal choledochus sac. If this, at the time of birth, has already attained large dimensions, the troublesome symptoms it produces come earlier than if the individual is born with a smaller cyst. The youngest of the patients observed with serious symptoms of the disease was 2 years old, the oldest 25—between these two ages lie all stages. The average age when the patient began to suffer from the disease seemed to have been from 12 to 14.

The principal *symptoms* produced by choledochus cyst are icterus, tumor and pains. The icterus has been intermittent and, in a number of cases, has passed into a continuous form of varying severity, in nearly all cases it has been remarkably strongly marked, in a couple to a very high degree—icterus melas. Only in one case, Smit's, it has been completely absent, in my case it existed only in subicteric coloring in the scleræ and urine. The most important symptom is, without doubt, the tumor, lying in the right hypochondriac region and almost always attaining a very considerable size. In none of the published cases was it of so small dimensions as in mine, where it was of the size of a fist. In several cases it has been as large as a child's or a man's head, or even larger. As a rule, it is situated immediately close to the liver, in certain stages, as in my case, it is clearly separated from it by a region with tympanitic percussion tones. In 5 of the published cases (Dreesmann's, Mayesima's, Arnold's, Seeliger's and Russell's) could be observed over the great tumor another smaller one, varying from the size of a hen egg to that of a goose egg, lying under the edge of the ribs, and having its origin in the equally palpable, somewhat distended gall-bladder. In the cases which have been observed long enough, the great tumor, as I have already mentioned, exhibited a peculiar variation in size and consistency, and this variation has been ascertained to result from the taking of food into the stomach, the tumor swells and becomes harder some hours after meal times, evidently in connection with the fact that the secretion of bile is most active at this time. The pains have varied



from more or less severe flatulency of the abdomen to the most violent colic pains. Their violence is usually in proportion to the icterus and the size of the tumor. These symptoms have generally been accompanied by fever, and the general condition has been more or less affected. Three times (in Ashby's, Mayesima's and Wettwer's cases) ascites has occurred, caused by the compression of the portal vein by the tumor. Further, the disease has generally developed at intervals spread over a varying period of time, and as a rule, finally showing very evident symptoms, once (Seeliger's case) exhibiting a real intestinal obstruction. A peculiarity of this disease is that it appears par préférence in the female sex, only in 5 of the known cases (Russell's, Weiss's, Mayesima's, Clairmont's and Butters') has it attacked boys. No one has given a satisfactory explanation of this very remarkable fact.

As regards to the *diagnosis* of the disease, this, as has been already mentioned, has hitherto not once been possible previous to operation. It has usually been mistaken for an echinococcus, pancreas or liver cyst. It seems, however, that if one is only acquainted with the fact of the existence of such a disease it would not be impossible to recognize it. Its appearance during the first two decades, as a rule, usually among females, with repeated attacks in the form of a large, cystic, sometimes in size alternating swelling in the right hypochondriac region, more fixed than a distended gall-bladder, conjoined generally with icterus, fever, more or less violent pains, these features, says Dreesmann, are so characteristic that a diagnosis of probability of choledochus cyst would be authorized.

With regard to the *therapeutics* of this disease, an investigation of the 30 cases in which operative measures were employed shows the following. In the majority of cases, namely in 21, the operative treatment consisted only in suturing the cyst in the abdominal wound and the application of an external fistula, in some cases after a preceding puncture through the abdominal wall. All these cases ended fatally a longer or shorter time after the operation, either from exhaustion caused by the enormous loss of bile through the fistula or on account of subsequent icteric hemorrhage or infection. In 1 case, however (Clairmont's), the patient lived three years with this fistula, and died of phthisis. In Ebner's case death occurred in the remarkable form of purpura hæmorrhagica fulminans three months after operation. In 3 of the 21 choledochostomy cases (Ashby's, Dreesmann's and Seeliger's) an attempt was made by means of a second operation to establish communication between the cyst and the intestine, death, however, resulted in all cases. In 1 case, operated on by Bakes, 1911, as well as anastomosis between the cyst and duodenum, a fistula at the same time was made externally, either on the choledochus or the gall-bladder (which does not clearly appear from the account given by the pathologist, Sternberg, who made the postmortem examination), this patient also sank from the operation. In 3 instances (Goldammer's, Lavenson's, and Smit's) the operation

## IDIOPATHIC CHOLEDOCHUS CYST

consisted in extirpation of the sac. Death ensued after the operation in these cases also. There remain 5 cases which were restored to health. In 3 of these cases an external fistula was made primarily, and communication between the cyst and the intestine was opened secondarily. In the first of these cases, operated on by Twain in 1894, the anastomosis was made with Murphy's button to a loop at the jejunum drawn up through an opening in the mesocolon. In the second, operated on by Brun and Hartmann in 1897, after a previous marsupialization of the cyst, choledoch-enterostomy was performed in a manner not fully described. The third, operated on by Hildebrand in 1912, was so far remarkable in that the anastomosis made between the cyst and the duodenum could not produce healing of the external fistula, evidently depending on the fact that it was of insufficient size, only when, in a third operation, a new larger inner fistula opening was made did the outward flow of bile cease and definite healing take place.

In the 2 other cases, that operated on by Bakes, 1907, the other my own case, has, as primary measure, a lateral choledochoduodenostomy been made, and both were restored to health.

Bakes' case was examined two years after operation, and the patient was then in perfect health. My case occurred only ten months ago, but from what I have learned the patient has been well ever since the operation.

It appears, therefore, from what has been said, that the opening of communication between the cyst and the intestine is the only rational therapeutic, and this ought to be done primarily.

Dreesmann feared that the application directly of connection between the intestine and the cyst would cause infection of the latter by intestinal bacteria and lead to progressive cholangitis and hepatic suppuration, he proposed, therefore, in order to reduce the risk of infection, which he feared, that the operation should be performed in successive stages; first by employing a gastro-enterostomy, two or three weeks later exclusion of the pylorus according to von Eiselsberg, and then making use of choledochoduodenostomy. Well thought out theoretically, this is not, however, to be recommended, partly because the patient is, as a rule, in a reduced icteric condition, which does not permit several trying operative encroachments, partly because, judging from the experience gained from several quarters, the danger of infection from anastomoses between the biliary passages and the alimentary canal is practically not so great.

Finally is hereby given a survey of the cases of idiopathic choledochus cyst described in literature, with short extracts from the descriptions of the cases.

### A OPERATED CASES

1 KONITZY, 1888. A woman of twenty-one. Ill six months. Rapidly increasing fluctuating tumor, extending from the liver to crista ili. Icterus. Operation. Extreme cystic dilatation of choledochus sac, which was incised. Died eight days after operation.

2 SEYFFERT, 1888. Woman of twenty-three. Suffered from icterus for two

years, with intervals of four months, for one year, increasing swelling of the abdomen and attacks of colic. Beside the gall-bladder, which was normal, a tumor as large as a child's head, which proved to be a gall-filled cyst. Drainage. Patient died one month later of violent hemorrhage, which could not be stopped.

3 ARNISON, 1891. The tumor was supposed in operation to be a pancreas cyst and was drained. The patient, who was very much exhausted, lived only a few days. In the postmortem the operation was found to have been choledochostomy and the tumor the dilated common duct.

4 SWAIN, 1895. A girl of seventeen. Had been ill two years. Increasing icterus and swelling of the abdomen for ten months. An enormous abdominal tumor filling the whole of the right side, and extending even to the left half of the abdomen. Puncture, discharge of six pints of a gall-colored fluid. Tumor formed again after five days. Operation. The cystic tumor was emptied of seven pints of gall-colored fluid. The gall-bladder was normal, and lay above the tumor. Gall-stone, at first supposed to exist, could not be found. Anastomosis between the cyst and jejunum with Murphy's button through mesocolon transversum. Recovery.

5 EDGEWORTH, 1895. A girl of four. Ill one year. Repeated attacks of icterus. Large abdominal tumor, diagnosed as distended gall-bladder, which was drained. Death one week after operation. The sac was found to be the enormously distended choledochus, stenosed at its lower end. Cystic duct obliterated.

6 BRUN-HARTMANN, 1897. A girl of three and one-half years with congenital dilatation of the choledochus. The cyst was first marsupialized by Brun. At the next operation Hartmann performed choledoch-enterostomy with success.

7 RUSSELL, 1897. A boy of eight years. Acutely ill for five days with fever and icterus. Right flank filled by a large distended tender tumor, extending downwards to the crista ili, forward to the middle line. Under the ribs another tumor, as large as a hen egg, insensitive, and not quite so distended. Diagnosis, echinococcus. Operation. Choledochostomy. Died four days after the operation of hemorrhage from the stitches, according to the account given. Postmortem showed that the cyst came from the choledochus and that the passage between this and the intestine was free. Russell regarded the formation as congenital and analogous with congenital hydronephrosis.

8 ASHBY, 1898. Girl of seven years. Ill two and one-half years with icterus, and increasing emaciation and finally swelling of the abdomen and œdema in the legs. After fifty ounces of ascites fluid had been tapped from the abdomen, a large cyst was observed in the right half of the abdomen, during a period of three months this was punctured eleven times and from eight to sixteen pints of gall-colored fluid drawn off each time. When the patient began to improve under this treatment a choledochostomy opening was made through which all the bile was drawn off. Two months later, an attempt was made to establish connection between the cyst and the intestine. Death from peritonitis ensued. "The cyst seemed to be formed by enormous distention of the common and cystic ducts. The hepatic duct opened into the cavity, but there was no connection between it and the duodenum."

9 ROSTOWZEN, 1898. A girl of thirteen years. For three years distention of the abdomen. Intermittent icterus for one year. Large tumor in the region of the liver, fluctuating in circumference and consistency. Temperature rising to 39°. The cyst which was firmly adherent to its surroundings was first emptied by puncture of two litres dark greenish brown fluid, then sewed fast to the wall of the abdomen and drained. Death the day after operation. Postmortem showed an enormous enlargement of the choledochus, the hepaticus also dilated. The cyst exhibited a kind of valve, and, like the gall-bladder, was empty. The choledochus was bent at an angle at the entrance into the duodenum, and passed obliquely through the front wall.

10 NICOLAYSEN, 1899. A girl of eight years. Icterus a year previously for three months. At her reception into Rig's Hospital in Christiania the patient showed a high degree of icterus, acholic stools, and a fluctuating resistance in the right side under the liver, seemingly as large as a man's head. A small incision was made in

the abdominal wall, with packing against the cyst in order to get cohesions forward Six days later the cyst was opened and emptied of one and one-half litre of gall-colored fluid Death ensued the following morning The postmortem showed that the cyst had originated through enlargement of the hepatic duct and the greater part of the choledochus, the lower portion of which, to a length of two cm, which was fully permeable, was not engaged in the dilatation The gall-bladder small, and communicating freely with the cyst "As concrements were not found anywhere, nor disease in any of the adjacent organs, one cannot suppose compression or obstruction of the common duct or the hepatic duct to be the cause, the smallness of the cystic duct being also opposed to this idea. The solidity and thickness of the cyst are also in favor of the theory that enlargement may have been taking place for a long time, perhaps even from birth"

11 DREESMANN Woman of twenty-four years Even as early as at the age of six months the patient had been yellow for a short period Since the age of three violent attacks, with vomiting From the age of eighteen the abdomen had been very much distended For two months severe icterus with fever Below the liver, a swelling as large as a man's head, tender to the touch, and, distinct from this under the edge of the ribs, a fluctuating tumor as large as a fist The distended gall-bladder, and the large cyst were both opened and drained An abundant flow of bile up to 1800 cubic cm daily Four and one-half months later, an attempt was made to form a connection between the cyst and the duodenum Sudden collapse of patient three days later The postmortem showed the absence of peritonitis The swelling was the enormously dilated choledochus, and the dilatation was continued up into the upper gall-passages The lower part of the choledochus to a length of three cm was not engaged in the dilatation and was easily probed, partly from the cyst, and partly from the papillæ vateri

12 KOLB, 1905 A girl of ten years For some months, distention of the abdomen and icterus Below the enlarged liver a distended elastic fluctuating tumor extending downwards to the smaller pelvis, and to the left to the left mammillary line Test puncture exhibited a gall-colored fluid, without echinococcus hooks A fortnight later operation (6-Angerer) After tapping the enormous cyst of one and one-half litre, it was sewed to the abdominal wall and drained Death ensued, not quite a month later Postmortem showed a cystic tumor into which the upper gall-passages opened upwards The connection of the cyst with the intestine was only found on microscopic examination and was situated somewhat to the side of the pancreatic duct

13 ARNOLDS, 1906 A girl of thirteen years Distention of the abdomen for two years Signs of obstruction of the choledochus for seven months During the last few weeks, strength greatly reduced Below the enlarged, strongly lobed liver in the middle of the abdomen a distended elastic tumor as large as a man's head, to the right of this another smaller cyst In laparotomy the right cyst proved to be the enlarged gall-bladder, the left the dilated choledochus, from which was discharged "half a bucket full" of gall-colored fluid Death ensued after twenty-four hours In postmortem access could easily be obtained to two passages as wide as the forefinger from the upper pole of the cyst These were the dilated hepatic ducts Downwards, connection with the duodenum was found in a short passage with a double angle bend

14 GOLDAMMER, 1906 A woman of twenty-one years Had undergone parturition three months previous to her entering the hospital During pregnancy no troublesome symptoms, but after confinement a swelling observed under the edge of the ribs on the right side, and increasing icterus made its appearance In the upper part of the abdomen a fluctuating non-sensitive tumor about the size of a child's head and connected with the liver Icterus in high degree Operation (Rummel) Extirpation of the cyst, which contained several litres of greenish-brown serous fluid Death from collapse Postmortem showed complete absence of the choledochus with the exception of its intraduodenal portion, and the cyst must therefore

have been the enormously dilated common duct. The gall-bladder was unaltered. The cut-off hepatic branches at their entrance into the liver were about the size of the forefinger. The intrahepatic gall-passages were much enlarged. No cause of the choledochus dilatation could be established.

15 BAKES, 1906. A woman of twenty-two years. Had suffered for three months from icterus without any other symptoms, except increasing loss of strength. Beside an icterus melas, with acholic stools, only a certain tenderness below the right edge of the ribs could be observed clinically. At operation a rounded cystic tumor as large as a child's head was found between the ventricle and the liver. Above the lower pole of this growth lay the duodenum in a strongly forward displacement. Gall-bladder normal. Papilla duodeni felt normal, without tumor or stone. It was supposed to be pancreas-mesenterial or kidney cyst. Test puncture gave thin yellow bile. Incision of the cyst, probing from the same to the intestine failed. Choledochoduodenostomy was performed and the patient recovered.

16 EBNER, 1909. A girl of eighteen years. At the age of nine temporary attack of gall colic. From the age of thirteen almost constant painful sensations in the region of the liver, with gradually increasing swelling there. Icterus for six months. Clinically a district of resistance of the size of a man's head in the right hypochondriac region, of distended elastic consistency. Operation (Leerer) showed a cyst lying spread out under the surface of the liver, and filled with thin fluid gall. The cyst had developed retroperitoneally in bursa omentalis. Was sewn to the abdominal wall and drained. Gall fistula. Lived three months in comparative health. At the end of this time an extremely violent purpura hæmorrhagica developed in a few days producing death. Postmortem showed an enlargement of the choledochus, of the size of a man's head, as well as dilatation of the duct hepaticus and orifice of duct cysticus. Remainder of cysticus as well as gall-bladder normal. The lowest undilated portion of the choledochus pierced the anterior wall in an oblique direction, and when probed showed a completely free passage.

17 LAVENSON, 1909. A girl of eight. Icterus one year. For three weeks a swelling in the upper part of the abdomen. Clinical examination showed a considerable cystic non-sensitive tumor in the upper part of the abdomen, attached to the liver, and extending somewhat below and to the right of the umbilicus, as well as a high degree of icterus, and discolored fæces. Operation (Frazier) a cyst as large as an ostrich egg, covered in its lower part by the duodenum, between the latter and the liver the somewhat distended gall-bladder. The cyst was loosened from its attachment to its surroundings and extirpated, and its pedicle ligatured. Death after three days. Postmortem showed that the tumor was a cyst from the choledochus 15x8x7 cm in size, gall-bladder somewhat dilated. Ductus cysticus obliterated, duct hepaticus dilated. The lower portion of the choledochus 3 cm in length between the cyst and the papilla vateri was in the form of a chord, as thick as a goosequill, in its upper third provided with lumen, in its lower two-thirds without. As well as this, chronic perilobular pancreatitis. Obliteration of lower portion of choledochus was regarded as the result of cholangitis.

18 WEISS, 1910. A boy of six years. Temporary attacks of pain in the right side, with icterus for more than a year. For half a year abdominal swelling. Clinical examination showed no icterus. Beneath the liver which was enlarged to a high degree a rounded tumor about as large as a fist, hard, mobile in respiration, diagnosed as echinococcus. After test puncture which yielded a clear yellowish-green fluid, symptoms of peritoneal irritation appeared, wherefore an operation was performed with sewing forward of the distended cyst in the abdominal incision, with three days later opening of the same. Death nine days later. Postmortem showed a flaccid cyst as large as a child's head proceeding from the choledochus, beginning at the junction of the cysticus and hepaticus. Sharply displaced upwards by a spur-like protuberance. Impossible to find duodenal opening. Hepaticus and extrahepatic gall-passages moderately dilated. Inner wall of cyst without epithelium. Weiss regards it as a congenital anomaly.

## IDIOPATHIC CHOLEDOCHUS CYST

19 BUTTERS, 1910 A boy of five, extremely icteric and emaciated Abdomen considerably distended, especially to the right, where a large tumor of smooth surface can be felt In operation a tumor was found below the liver from which was drawn three litres of gall-colored fluid Death after some days of exhaustion Post-mortem, choledochus cystically dilated to a high degree

20 ERCNER, 1911 Woman of twenty-three Icterus in a high degree for one month Wrongly diagnosed for pancreas cyst and operated Postmortem (Professor Weichselbaum) showed a case of cystic enlargement of the choledochus containing five litres (this case is probably identical with that demonstrated by Miloslavich at the conference of the Society of Army Doctors of Vienna (Verein der Garmsonsartze) on the 18th of November, 1911)

21 CLAIRMONT, 1911 A man of twenty-two The previous history was characteristic, and the clinical appearance that regularly met with in these cases That, namely of a large area of resistance, not distinguishable from the liver, situated under the edge of the thorax, and showing indistinct fluctuation, also icterus Operation (v Eiselsberg), after puncture of the cyst, which was as large as a child's head and contained two litres of pure gall, it was sewed to the abdominal wall and drained In the evening of the day of the operation, the patient's life was threatened by severe hemorrhage, which, however, was checked Richly secreting gall fistula, which, however, interfered but little with the patient's comfort Death three days later of phthisis, and hemorrhage from the lungs In the postmortem was found a fold of the membrane between the extra- and intraduodenal parts This had probably caused an obstruction

22 STERNBERG, 1911 A woman of twenty-five years Operation performed by Bakes consisted of cholecystostomy and choledochoduodenostomy resulting in death "after some time" At the postmortem performed by Sternberg the gall-passages were found to be greatly enlarged, the choledochus formed a very large cyst, fastened on one side to the wall of the abdomen, and on the other to the duodenum, and open in both directions Neither in the papilla vateri nor in the lower narrow portion of the choledochus was any alteration to be found in the form of a scar or similar formation, and there was also an absence of concretions It was, therefore, a case like Ebner's of so-called "idiopathic choledochus cyst" At the point where the narrow part of the choledochus penetrated into the cyst a half-moon-shaped fold was found

23 SCHLOESSMANN, 1911 A girl of seven Had suddenly become ill with symptoms of peritonitis and icterus, while at the same time a resistance appeared in the right hypochondriac region The reaction from the peritoneum disappeared, but the tumor, which clearly was cystic, remained A test puncture was made, giving clear greenish fluid In connection with this arose violent abdominal symptoms which necessitated an immediate operation (Sprengel) Gall peritonitis with fatty necrosis in the abdomen Below the liver a cyst of the size of a child's head, adherent to its surroundings, this was opened and drained Death from sepsis six days later The postmortem showed that the cyst was formed from the choledochus duct, which was enormously dilated from its beginning to the vicinity of the papilla vateri The cysticus and hepaticus opened into the upper part of the cyst in the lower, the terminal part of the choledochus protruding at an acute angle, in all three places, a fold could be discerned from inside Gall-bladder small Under the microscope the cyst wall was found to be a fibrous membrane, without elastic elements, and containing very few muscular fibres

24 MAYESIMA, 1912 A boy of two years and two months For ten months the child had had a gradually increasing swelling of abdomen, for four months icterus In the upper part of the abdomen a tumor about as large as a man's head, filling out the right side and lower thorax aperture, extending over to the left mammillary line, downwards a finger's breadth above the symphysis, backwards to the region of the loins In the place of the gall-bladder another tumor, rounded, about as large as a goose egg Also ascites, and slight icterus Operation, puncture of the enormous

cystic tumor, and tapping of two litres of gall-colored fluid In consideration of the child's precarious condition, further intervention was refrained from for the time The puncture and the abdominal incision were sewed up The patient got over the operation, but died two months later Postmortem showed the cyst to be formed of the enormously dilated choledochus, its lower part only was of normal calibre, and had retained the lumen, but it was slightly kinked and passed in a valviform bend, obliquely downwards from the right, upwards to the left to the cyst

25 HILDEBRAND, 1913 The patient, whose age and sex are not mentioned, had in the upper right hand portion of the abdomen a large cystic fluctuating tumor, also icterus in a high degree and acholic stools In operation were found a distended gall-bladder, and a large cyst under the liver, which was pushed upwards by it The cyst which contained four litres of bile, was opened and drained There was a flow of bile outwards, but no bile in the intestine At a new operation an anastomosis was made between the cyst and duodenum In the beginning some of the bile went to the intestine, but not later on The gall fistula would not close up At a third operation, a new and larger anastomosis was made between the cyst and intestine Sometimes the contents of the intestine entered the cyst and were discharged through the fistula Hildebrand feared infection of the cyst, which, however, did not take place, and normal conditions were restored with the healing of the fistula The patient was demonstrated in good health one year after the operation in Berlin's Gesellschaft für Chirurgie (Surgical Society of Berlin) July 14, 1913

26 SEELIGER, 1913 A girl of thirteen years The patient, who up to that had been healthy, had become ill some days previously with increasing ileus symptoms together with severe icterus The abdomen, as a whole, much swollen, especially so in the right upper part, where there was considerable tenderness and rigidity In the place of the gall-bladder, a smaller limited swelling Operation showed a large cystic tumor on whose front side passed the duodenum, pressed quite flat, upwards to the liver the distended gall-bladder Puncture, giving 750 cubic cm of gall-colored fluid The cyst was fixated to the abdominal wall and opened four days later An abundant flow of bile and disappearance of icterus, fifteen days later at a second operation, an attempt was made to produce a connection between the cyst and duodenum, a very complicated operation Death took place a week later Post-mortem showed limited peritonitis, the cyst had sunk together into a cavity as large as a child's head into which opened upwards duct cysticus and hepaticus, its lower connection with the duodenum could not, however, be ascertained with accuracy

27 SCHILBE, 1913 The patient, a woman of twenty-five years, had never had any disturbance of the gall-passages previously, she came to the hospital with icterus of three months' standing, for some time high fever almost every day and a tumor twice the size of a fist, below the liver Marsupialization of an enormous cyst between the liver and duodenum and ventricle, giving nearly four litres of gall-colored fluid Fever continued, and icterus did not diminish, there was a strong flow of gall Death took place eight days later from violent hemorrhage from the wall of the cyst Postmortem showed that the cyst was the highly dilated common duct The gall-bladder was small, the hepatic and the intrahepatic gall-ducts enlarged Probing of the lower part of the choledochus from papilla vateri took place without any difficulty

28 IPSEN, 1913 A girl of eighteen Had suddenly become ill, six weeks before her reception into a county hospital, with pains under the right ribs Three days later, icterus with dark urine and acholic stools, her condition remained unchanged Was received into Rig's Hospital, Division C, June 6, 1912 Icterus in high degree The right upper part of the abdomen occupied by a considerable swelling Supposed to be caused by choledochus stone with gall stagnation in the liver At operation, June 10, an enormous enlargement of the choledochus was found, and this contained about two litres of bile-like clear fluid The hepatic duct and gall-bladder also much enlarged No stone, no opening into the intestine to be

seen Drainage of gall-bladder and choledochus cyst Severe cholangitic hemorrhage for a week, after which, however, the patient recovered somewhat, and the icterus diminished The gall entered the intestine a month later, July 11, 1912, but death resulted from fresh hemorrhage Postmortem showed the much shrunk choledochus cyst, which communicated with the intestine by a cord, fine as a hair upwards, but somewhat thicker downwards

29 SMITH, 1915 A girl of seventeen For five years increasing swelling of the abdomen, for four years periodic pains in the epigastric region, occurring regularly for three or four hours in the afternoon, and lasting on towards the evening Never icterus Protuberance of upper part of abdomen and lower part of thorax, proceeding from a considerable tumor which occupied the right hypochondriacal and the epigastric region Diagnosis, liver cyst (possibly echinococcus) or pancreas cyst Operation, January 28, 1915 A rounded cystic tumor of the size of a man's head, firmly adhering to the under surface of the liver Puncture, giving gall-colored fluid "As one could not be certain regarding the point of origin of the cyst, and an incision with drainage does not appear to be very satisfactory, extirpation of the same was performed" In the course of this it was necessary to ligate four string-like formations, three from the upper part of the cyst going into the liver, and one from its lower part, 3 cm long and as thick as a match, going towards the pancreas, all provided with lumina The cyst contained three and one-half litres gall, in its wall lay the gall-bladder like a blind sac of the thickness of a lead pencil opening into the cyst, its place of entrance as well as those of the upper and lower gall-passages covered by crescent-shaped folds Death eight days after operation Postmortem showed that the duodenal part of the choledochus, which had been ligated 2 cm from the papilla vateri, did not exhibit any stricture

## B NON-OPERATED CASES

30 DOUGLAS, 1852 A girl of seventeen For an uncertain time pains in the liver, icterus in a moderate degree, and a swelling gradually increasing in size in the right hypochondriac region This was accompanied by fever, wasting, and œdema in the legs Test puncture showed gall-colored fluid Death a fortnight later Excessive enlargement of the choledochus, containing half a gallon of very ill-smelling gall, hepatic branches as thick as a finger Gall-bladder and cysticus not enlarged In the lower part of the cyst a funnel-formed opening, provided with a valve, leading into the lower, not dilated portion of the choledochus

31 HEID, 1893 A girl of fourteen For about six weeks pains in the region of the umbilicus, increasing icterus, and swelling of the abdomen A considerably enlarged liver had been observed, below which was found a rounded tumor of a size and consistency varying with different occasions Postmortem showed a liver weighing 3035 grams, a cystic enlargement of the choledochus as large as a child's head, its lower part 21 cm long was not engaged in the dilatation, and was kinked, but could be easily probed from the intestine

32 BROCA, 1898 At the postmortem of a ten-year-old girl was found a cystic enlargement of the size of a child's head The passage showed no obstruction or obliteration, but an angular curvature between the cyst and duodenum

33 WETTER, 1905 Girl of fifteen From the age of five had been subject to attacks of cramp of the stomach with vomiting, from the age of seven occasional icterus In the epigastric region a rounded, soft tumor, sensitive to the touch, the size and consistency of which were increased after meals Besides this icterus, fever and signs of ascites Postmortem showed tumor twice the size of a fist, originating from dilatation of the choledochus The lower part of the passage bent at an angle, going downwards from the cyst upwards to the duodenum was easily probed

34 HEILIGER, 1910 Described in text



In all the cases quoted above, the diagnosis of idiopathic choledochus cyst seems to be without doubt. In the literature on the subject there are, however, several cases related, of a high degree of cystic dilatation of the choledochus, which, either on account of incomplete data or from the existence of a real hindrance in the form of stone, tumor formations in the lower part of the choledochus, or chronic pancreatitis, cannot be reckoned offhand as belonging to this category, despite the fact that the pathogenesis not improbably—at least for some of them—seems to be the same.

To these cases belong Todd's (1817), Fabre's (1831), Barlach's (1876), Legg's (1876), Raynaud and Sabourin's (1879), Oxley's (1883), Wilkes-Moxon's (1889), Brunner's (1889), Mayo Robson's (1893), Eve's (1906), and Milner's (1909).

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# RELATIVE INDICATIONS FOR CHOLECYSTECTOMY AND CHOLECYSTOTOMY

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For years these operative procedures, cholecystectomy and cholecystotomy, have been discussed *pro* and *con*. Each has its place in the armamentarium of the surgeon.

A few years ago the drainage operation was the procedure of choice. To-day cholecystectomy is performed by most surgeons. Many circumstances have brought about this radical change.

Cures were not effected when there was every reason to believe there would be. The old symptoms of pain and distress returned. Cholecystitis recurred and far too frequently gall-stones were found. Secondary operations were necessary in many cases because of a return of the original symptoms. The surgeon was not satisfied with his work, the spirit of unrest and dissatisfaction pervaded the operative procedure for cholecystitis with and without gall-stones.

Flexner tells us the gall-bladder acts to render the bile less irritating to the pancreas. Another function of the gall-bladder is to pump the bile into the intestine. Pressure seems necessary to carry the bile through the ring sphincter muscle of Archibald at the ampulla. This is one reason the gall-bladder was thought needed by its rhythmic contractions to force the bile into the intestine. Drainage of the gall-bladder, because of adhesions to it, partially destroys this pump-like action.

It is found in certain clinics that one in every seven women is afflicted with gall-stones, and one man in every eleven. Cholelithiasis must then be considered one of the most common diseases of the upper abdomen. Gall-stone colic is not necessary to have gall-stones, in fact, many times gall-stone colic is a persistent symptom where no gall-stones are found. The gall-bladder may be filled with stones and the patient have no symptoms of the disease. Gall-stones may remain quiescent in the gall-bladder for a long time and be discovered when operating for other conditions and at autopsies.

Considering cholelithiasis as one of the most common diseases of the upper abdomen, the treatment is of vital importance. It is strictly a surgical disease and should be treated surgically and as soon as diagnosis can be made. A continued irritation of the gall-bladder by stones and cholecystitis is, undoubtedly, a causation factor in the production of malignancy. The operations for this condition, cholecystotomy or cholecystectomy, are operations which have been much discussed and about which many volumes have been written. Deaver says, as far as the operative interference is concerned, in experienced hands the mortality is about the same.

## RELATIVE INDICATIONS FOR CHOLECYSTECTOMY

The frequency with which these cases are afflicted with recurrence is, I believe, largely responsible for the wide variance of opinion regarding the operation of choice. Why should so many cases recur after operation if all the stones are removed at the time of operation? Gall-bladders and ducts in which there have been stones for a long period of time, even years, must undergo pathological changes of many difficult kinds. The gross anatomy of a gall-bladder filled with stones or partially filled with stones changes in size and appearance. In some cases a gall-bladder becomes twice its normal size, and the bladder wall thick and tense from frequent exacerbations of cholecystitis. Gall-stones which plug a duct cause dilatation of the duct in which they are lodged. Is it any wonder after all these changes from normal to abnormal, and from anatomical to pathological, the ducts distorted and tortuous with numerous dilatations, contractions and adhesions, that stones escape detection? Considering recurrence from this phase, it seems more than likely that many cases of so-called recurrences are not recurrences in the truest sense, but are caused by stones escaping detection at the time of the operation. Undoubtedly a good many cases of so-called recurrences are caused by a stone or stones escaping detection. On the other hand, if all the stones are removed at the operation and the causes which are necessary for the formation of gall-stones are still remaining, what will prevent reformation?

Cholecystotomy will not permanently cure gall-stones if a diseased appendix remains to distribute infection to the gall-bladder contents and cause attacks of cholecystitis, with bile stagnation in the gall-bladder and the precipitation of bile salts. Rosenou has shown that the infection of the gall-bladder is interstitial. With every condition needed for the reformation of stones, a recurrence is inevitable. This seems to me to be a very strong argument in favor of cholecystectomy. The gall-bladder is the most common site in which the stones are found, and the cystic duct the most common duct to be affected. They also occur in the hepatic and common ducts.

Seventy-five per cent of gall-stones are found in women and in eighty per cent of these women the symptoms develop during pregnancy (Mayo).

One-fourth the diseased gall-bladders with symptoms of cholelithiasis do not contain stones.

The symptom of gall-stone colic is caused by mucous balls and thick, heavy bile. It is the violent peristalsis which causes the colic.

The entire function of the gall-bladder is unsettled. Many theories have been expounded. Cases enjoy the best of health and suffer no recurrence following cholecystectomy. In view of the facts, namely, the frequency of recurrence from stones being overlooked, also the conditions needed for reformation remaining, and the gall-bladder the most common location, cholecystectomy seems to be the preferable operative procedure.

As to the mortality, cholecystectomy seems to have had a larger death rate. It is undoubtedly a more serious operation.

The technic followed by most surgeons to-day is through a median high incision, if needed, to the ensiform cartilage, so that the liver can be rolled out toward the median line, using the gall-bladder as a tractor, thus exposing the gall-bladder to view and making it so accessible for operation

When the gall-bladder gives marked evidence of associated functional derangement of the stomach, cholecystectomy should be performed, whether or not stones are found (Mayo)

No absolute rule can be laid down for either cholecystectomy or cholecystotomy. Many circumstances may interfere. There is little doubt that removal of the gall-bladder is a longer operation and entails more trauma. Indications for cholecystectomy may be present, but the condition of the patient may not warrant this operation. Every case, it seems to me, must be a law unto itself. Generally speaking, cholecystectomy should be performed when the following conditions are present: First, when the stones occupy the gall-bladder, second, cholecystitis without stones, third, where wall of gall-bladder is diseased, fourth, stone in cystic duct or any obstruction to cystic duct, fifth, adhesions around the gall-bladder which interfere with its pump-like action, sixth, in the case of the strawberry or papillomatous gall-bladder, seventh, malignancy.

Cholecystotomy should be used. First, in cases of pancreatitis with jaundice, second, in the very old and feeble cases or in those cases of poor physical conditions, third, in those cases where the operation would be dangerous because of the inaccessibility of gall-bladder.

It seems that both operations have a very important field. It is not a case of elimination of one or the other, but a case where each operation has very definite indications, as has been shown by Deaver, Mayo, Judd, and others.

The appendix is the focus of infection of most upper abdominal diseases (Deaver).

As infection plays such an important rôle in the production of gall-bladder diseases, it behooves us in all cases to examine and remove the appendix should there be the slightest indication.

## TORSION AND INFLAMMATION OF THE APPENDICES EPIPLOICÆ

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THE appendices epiploicæ were first described by André Vesalius. Later, anatomic studies were made by Fabricius, Spiegel, Riolan, Glisson, Bartholin, and Willis. The modern anatomists give but scanty references to these structures. This is strange, because the appendices epiploicæ have a special and definite anatomical system, and in addition present a surgical interest owing to their peculiar and important pathology. It is a question whether the term appendix epiploica is sufficiently definite and descriptive, owing to the failure to suggest the peritoneal origin and nature. In order to obviate this criticism, Robinson recommends the use of the term, Sero-appendix-epiploica. He adds to this expression the words, pericardial, pleural, synovial, to indicate the fatty tabs that are found in the pericardium, pleural cavity, and in the joints, and that have a similar histological structure. Among the numerous and varying terms used by anatomists are appendices epiploides (Meckel), appareil sero-graisseux (Poirier), and omentula. Attention has been called to the possible verbal confounding of the appendix epiploica with the vermiform appendix. This is likely in the older literature, in which surgeons and anatomists used the term appendix to designate a diverticulum. Discrimination is needed in this regard, because intestinal diverticula,—for example, Meckel's diverticulum,—may form the sole content of an abdominal hernia.

The appendices epiploicæ are generally arranged in two rows along the wall of the large intestine. They are in intimate relations to the longitudinal bands of the colon. It may be recalled that the muscular coat of the large intestine consists of external longitudinal and internal circular fibres. On the cæcum and the ascending transverse and descending colon, the longitudinal fibres are arranged in three bundles, known as the *tæniæ coli*, the intervening part of the wall being almost destitute of longitudinal fibres. These three bundles unite at the attachment of the vermiform appendix to the cæcum. From this point, an anterior *tænia* (*tænia libera*) passes to the front of the cæcum and then ascends in a similar fashion on the ascending colon. These longitudinal bands or *tæniæ* are called, according to their location, the anterior, the posterior superior, and the posterior inferior. The line of origin of the appendices epiploicæ coincides very closely to the anterior and the posterior inferior *tænia*. Occasionally one row of appendices epiploicæ exists, rarely are there three rows. The vermiform appendix has two rows of appendices epiploicæ, one on each side and projecting from its mesentery close to the appendix. They are best marked on the transverse colon and on the pelvic colon. They are seldom conspicuous

on the cæcum On the ascending and descending colon, they are mainly attached to the median and lateral surfaces On the transverse colon, they spring almost entirely from the anterior surface, being attached between the two longitudinal bands—termed *tænia mesocolica* and *tænia libera*—and when well developed form the adjacent part of the transverse colon On the pelvic colon, they often form two somewhat irregular rows, situated on each side of the bowel, they gradually become smaller in size and fewer in number toward the end of the pelvic colon They are absent from the rectum

The shape varies greatly They may be conical, saccular, lobulated, cylindrical, or flattened with the borders more or less fringed As they are formed by a simple reduplication of the peritoneum, there exists a potential space between the two serous surfaces By the injection of fluid or by the insufflation of air, the capacity of the cavity has been determined to range from one to ten c.c. of distilled water Distention of these spaces has been found at autopsy in patients dying from ascites or anasarca The conical type may be as long as 15 centimetres The smallest is less than one centimetre long The weight varies from 25 centigrammes to one gramme or more, according to the amount of fat present About one hundred is the average number present in an individual In three cadavers examined, the following figures were obtained 82, 95 and 108

The appendices epiploicæ that arise from the posterolateral *tænia* come in contact with the parietal peritoneum Those arranged along the postero-medial *tænia* are in relation with the mesentery of the colon Occasionally an appendix epiploica comes in contact with one of the potential hernial orifices of the abdominal wall, such as the inguinal, femoral, or umbilical An appendix epiploica may occupy one of the retroperitoneal fossæ, such as the intersigmoid The blood supply is derived from the superior and the inferior mesenteric arteries These branches arise from the vascular arcade formed on the anti-mesenteric border of the intestine and pass directly to the distal extremity of the appendix The veins empty ultimately into the superior mesenteric, the inferior mesenteric, and occasionally the renal veins The lymphatics have not been studied

The physiological value of the appendices epiploicæ remains unknown That they play a part in some physiological process is quite probable Because of their close resemblance to the omentum, it has been assumed that they possess a similar function The animal experiments and the deductions therefrom concerning the function of the omentum are well analyzed and presented in Robinson's thesis He points out that a general conclusion is reached that the omentum is a protective and defensive organ whose function is to filter and destroy bacteria, to render innocuous, harmful toxins, and to act as a leucocytic and phagocytic organ That the appendices epiploicæ—simple in structure and presenting no evidence of a specialized function as indicated by a complex histology—act like the omentum is extremely unlikely

Robinson is of the opinion, however, that the appendices epiploicæ are

concerned with the movement of fluids in the large intestine. This belief is based upon a cadaver experiment in which water under varying pressure was injected into the colon and the behavior of the appendices epiploicæ noted. The experiment consisted in ligating the terminal ileum close to the ileocæcal valve, opening the ileum distal to the ligated point, and inserting therein a cannula. The cannula, in turn, was so connected with a capacious syringe that water could be introduced into the colon deliberately and under varying pressure. Robinson noticed that as the fluid flowed through the colon the appendices epiploicæ became raised from the surface of the intestine so that they projected directly outward. If the fluid ran rapidly and continually, and was permitted to escape per anum, unhindered, the appendices epiploicæ produced a curious, fluttering dance-like movement which the experimenter aptly compares to the view produced by a forest of trees when viewed from the window of a rapidly moving train. The experiment was varied by partial or complete obstruction of the colon. This modified the motion of the appendices epiploicæ. These experiments have not, to the writer's knowledge, been repeated or verified.

An analysis of the literature discloses the fact that the essential and dominant lesion in the pathology of the appendices epiploicæ is torsion or twisting of the pedicle. If this is associated with infection, the conditions assume a practical and surgical importance, owing to the relief obtainable through operative intervention. If infection is absent, the pathology becomes of academic interest, for under these circumstances simple necrosis of the pedicle results in detachment of the distal end, which then becomes a foreign body of the peritoneal cavity. If infection is associated with the lesion, peritonitis may develop, and, in passing, it is important to state in this connection that torsion of an appendix epiploica is a possible source of infection in so-called cryptogenic peritonitis.

It is not definitely known how bacteria reach the appendices epiploicæ. Their probable source is, undoubtedly, from the colon. In a case reported by Riedel, a free culture of colon bacilli was obtained from the interior of an inflamed and twisted appendix epiploica. These phenomena—torsion and inflammation—may take place though the appendix epiploica lies not in the abdomen proper but within a hernial sac.

The occurrence of foreign bodies in the peritoneal cavity has been known for many years. Cruveilhier was the first to mention this topic. He did not, however, associate their origin with the appendices epiploicæ. He pointed out, however, the liability of these foreign bodies to cause peritonitis, and incidentally called attention to the striking similarity between these and the loose bodies of the joints, a relation that, of course, is actual. Deville, in 1851, exhibited before the Société Anatomique five foreign bodies which were found in the peritoneal cavity at autopsy. Though an inspection of the transverse colon revealed an appendix epiploica on the verge of becoming detached, Deville failed to associate this lesion with the formation of the loose bodies. He mentioned casually, however, the striking simi-



larity in appearance between this particular appendix epiploica and the foreign bodies

Virchow was the first pathologist to demonstrate the actual etiology and formation of the foreign bodies of the peritoneal cavity. He showed that as a result of obesity or an infection an increased amount of fat is deposited in the appendices epiploicæ. This fat undergoes saponification and calcification, which causes an increase in weight, and which in turn leads to gradual and progressive obliteration or obstruction of the blood-vessels of the pedicle. When the vascular obstruction or obliteration is complete, necrosis occurs and the freed and liberated appendix epiploica then falls into the peritoneal cavity.

Some time before Virchow presented his explanation, Hodgkin had called attention to the condition, in describing cases found at autopsy. Like Cruveilhier and Deville, he failed to recognize these foreign bodies as detached and calcified appendices epiploicæ.

Intra-abdominal torsion and inflammation may produce abdominal and peritoneal symptoms which are acute in onset and which simulate closely those of acute appendicitis. A case in point is the following, which came under the writer's care and observation in the second surgical division of Fordham Hospital.

M. G., single, age twenty-nine years, admitted December 12, 1916. Occupation, Cashier. Family History, Parents living and well. Two brothers and one sister alive and well. Previous History, Measles at age of six years. No other illness. Always constipated. Appetite excellent. Sleeps well. No disturbance of urination. Smokes a good deal. A moderate use of whiskey. No previous surgical condition or operation. Venereal History, Denied.

Present Illness, Began two days ago. Was awakened from a sound sleep with severe sharp pain in the right lower quadrant close to the median line. The pain did not radiate. It was increased by reclining, and alleviated by walking, and the application of a hot water bag. The taking of sodium bicarbonate and hot whiskey failed to give relief. Soon after the onset the patient took castor oil, which was rapidly vomited. He has not vomited since. An enema failed to secure a bowel movement, the bowels have not moved for four days. The pain increased in severity, in spite of the use of opiates. Chief complaint on admission, severe pain in the lower right quadrant.

Physical Examination, Patient has a moderately strong physique. Heart and lungs negative. The abdomen was distended. Tenderness over McBurney's point. Slight rigidity. No mass felt. Temperature, 100, pulse, 98, respiration, 24. Urinalysis, cloudy—straw color—sp gr, 1.016, acid, faint trace of albumin. No casts.

The diagnosis of acute appendicitis was made. Acute cholecystitis was excluded owing to the low situation of the tenderness.

Operation, Ether narcosis. Right rectus incision, no free fluid. The appendix was easily found. It was small, almost obliterated, and not inflamed. The abdomen then systematically explored. The stomach, duodenum, gall-bladder, kidney, and small intestine presented

no evidence of disease. It was evident that the appendix was not the cause of the symptoms. At the completion of this examination, the sigmoid was inspected, with the view of looking for a diverticulum. The sigmoid was extremely long and redundant and could be easily brought out through the rectus incision without traction or dragging. At the middle of the convexity of the sigmoid was found an appendix epiploica presenting evidence of acute inflammation. The pedicle was twisted. The appendix epiploica was removed by ligation of the pedicle. Appendectomy. Closure of abdominal wound. Complete recovery.

Pathological Examination (No 6033) The specimen sent for pathological examination was an appendix epiploica, consisting of a large amount of fat tissue with variously sized endothelial cells surrounded by a capsule of fibrous connective tissue. Parts of the capsule are infiltrated with inflammatory corpuscles, and the endothelial cells have undergone various degrees of proliferation. The specimens show an acute inflammatory condition without degenerative changes.

The cases reported by Briggs and Zoppritz are similar to that of the writer, save that in their cases the appendices epiploicæ were attached to the cæcum.

That an appendix epiploica might cause acute intestinal obstruction by acting like a band, was first noted by Ciuveilhier. Cases of this nature have been reported by Riedel and Schweinberg. Malgaigne and Ciuveilhier were the first to point out that femoral, inguinal, and umbilical herniæ may exist, the solitary content of which may be an appendix epiploica that may remain there for many years and not provoke trouble. On the other hand, torsion and inflammation may occur while the appendix epiploica is in the sac, the symptoms mimicking those of incarceration or strangulation. The same pathological process, necrosis and the formation of foreign body, may occur within the hernial sac. An appendix epiploica may adhere to the wall of the sac and thereby cause a hernia to be irreducible.

An inflamed and twisted appendix epiploica should be removed. Simple ligation is sufficient. The diagnosis will remain obscure until more cases have been collected and the histories and symptoms analyzed. Removal is indicated when the appendix epiploica produces obstruction by its band-like action. If casually found in a hernial sac, it should be advantageous to practise excision, because the vascular disturbance might favor the occurrence of torsion if the appendix epiploica were returned to the abdomen.

#### APPENDICES EPIPLOICÆ AS FOREIGN BODIES

CASE I—LITRE (*L'Histoire de l'Académie Royale des Sciences*, 1703, p 38. Abstracted by Robinson.) Litre during the dissection of a cadaver found a hernia, the sac of which did not communicate with the abdominal cavity as the neck was greatly narrowed. A portion of the omentum was attached to the circumference of this opening. In the same abdomen, Litre found a hard oval body one inch long, ten lines broad and seven lines thick. It was free and

unattached In the centre was a round stone, white, and about the size of a pea

CASE II—LAVERAN (*Gazette des Hôpitaux*, 1895, No 119, p 474) In an autopsy on a patient dead from chronic dysentery, the intestinal loops were firmly adherent and in the centre of this mass were twelve fibrocartilaginous bodies, the size of a small ball, with elastic resistance and a stratified structure

CASE III—CRUVEILHIER (*Anatomie pathologique générale*, tome III, 1894, p 816) In the abdomen of a soldier dead from an unknown illness, was found a foreign body the size of a billiard ball It was free with no trace of adhesions or pedicle The color was white and the surface smooth It was of extreme hardness Cruveilhier adds, that he has been told of a case of strangulated hernia, in which the surgeon found a free foreign body the size of a pea, in the sac It was a free cartilaginous body The patient recovered

CASE IV—VIRCHOW (*Die Krankhaften Geschwulst*, Berlin, 1863) Details a case in which the foreign body was hard, and calcified It lay free in the abdominal cavity As the patient had had symptoms of peritonitis, it was suggested that the foreign body came from the vermiform appendix But an analysis of the free body failed to show the signs of an fecolith The vermiform appendix was furnished with appendices epiploicæ, and at its tip was a small atrophied appendix epiploica, which caused one to assume that the foreign body had this origin

CASE V—SCHEDE (*Aeitzlich Verein* Hamburg 1894) Reported a case, before the Medical Society of Hamburg, of a foreign body free in the peritoneal cavity The patient presented the symptoms of ileus At operation a tumor was felt in the pelvis It was hard and about the size of an egg The mass was free It was removed and found to be a calcified appendix epiploica

CASE VI—TOMELLIMI (Abstracted by Robinson) During an autopsy in a man dead from cardiac paralysis, it was noted that the appendices epiploicæ of the transverse colon and sigmoid were straighter than usual Tomellimi found a flattened appendix epiploicæ, the same color as the others, bound to the fatty mass by a thin pedicle On examination, this pedicle was found to have undergone a true torsion around its long axis

CASE VII—NERI (*Riforma medica*, 1904) Observed during laparotomy several corpora aliena composed of fatty tissue within a connective-tissue envelope

CASE VIII—RIEDEL (*Munch med Wochen*, Nov 28, 1905) Male The symptoms presented resembled those of biliary colic The diagnosis was adhesions around the gall-bladder Operation showed two foreign bodies in the abdominal cavity They were formed from the appendices epiploicæ The operation did not cure the patient The pains returned, and at the end of three years he committed suicide At autopsy, two other foreign bodies were found

CASE IX—RIEDEL (*Ibid*) Male, age twenty-five years Four years before he had been operated upon for an appendical abscess The

distal (gangrenous) part of the appendix was removed Three weeks before admission, an abscess formed in the umbilical region, and ruptured spontaneously No fistula As a large hernia existed in the original incision and as the cause of the umbilical abscess was not known an operation was performed A median laparotomy disclosed two foreign bodies in the peritoneal cavity They were yellow and round They were 1.5 cm long, and .75 cm thick

CASE X—RIEDEL (Ibid) Male, age thirty-two years Complained of pain in the gall-bladder region, accompanied with jaundice Examination showed a large liver, no tumor, no fever At operation, no calculi were found The gall-bladder was removed on a suspicion of cholecystitis Two foreign bodies were found slightly adherent to the under surface of the liver They were round and fatty They were  $\frac{3}{4}$  cm long

CASE XI—RIEDEL (Ibid) Female, age 41 years For eight days previous to admission had complained of pain in the hypogastrium, painful micturition, chills, vomiting finally becoming fecal in character Examination showed great distention of the small and of the large intestine Marked signs of peritonitis As cause of this peritonitis, an appendix epiploica of a semilunar shape was found attached to the descending colon The extremity was fat, grey, 1.5 cm long, and 1 cm wide and not twisted Abdomen closed after lavage Death Autopsy showed no other cause of peritonitis In the centre of this foreign body composed of fat, were found colon bacilli.

#### APPENDICES EPIPLOICÆ AS CAUSE OF INTESTINAL OBSTRUCTION

CASE I—RIEDEL (*Munch med Woch*, No 28, 1905, p 2308) In this case, the distal distended end of an appendix epiploica was in the form of a foreign body This was shrivelled up in the centre, greyish color and isolated in the abdominal cavity The corresponding pedicle, which in fixing the small intestine had caused the ileus, originated probably from the cæcum, though this was not definitely determined A microscopical examination of the distal end of that part of the pedicle surrounding the small intestine, showed it to be composed of fatty tissue without nuclei The foreign body was also formed of non-nucleated fat tissue Riedel concludes from this that the foreign body and the pedicle were of the same nature

CASE II—RIEDEL (Ibid) Male, age forty years Three days before admission, complained of severe abdominal pain Vomiting Examination disclosed a robust man, abdomen slightly distended, no tumor, no visible peristalsis Operation showed the jejunum greatly dilated Free peritoneal fluid In the right iliac fossa was an appendix epiploica twisted at its middle and gangrenous at the distal end It arose from the median band of the cæcum and was adherent, by its twisted and gangrenous extremity, to the mesentery of the small intestine The centre part of the appendix epiploica crossed the ileum 10–12 inches above the ileocæcal valve Where it crossed, it produced an obstruction The appendix epiploica was removed and the obstruction relieved by enterotomy Death Autopsy disclosed peritonitis

TORSION AND INFLAMMATION OF AN APPENDIX EPIPLOICA

CASE I—BRIGGS (*Amer Jour of Med Sciences*, No 135, 1908, p 869) Male, age thirty-five years Previous history negative Five days before admission, he had a severe pain in the right iliac region This subsided with morphine medication Examination revealed tenderness over the appendix and a mass in the right iliac region The pulse was 80, temperature normal These findings remained unchanged for five days when the temperature became 100, and operation decided upon Operation revealed a dense tumor one and one-half inches long, and one inch in width, having the appearance of a hæmatoma with a peritoneal envelope It was unusually adherent and was attached to the cæcum by a narrow and twisted pedicle The appendix, though normal, was removed Recovery Microscopic examination showed the tumor to be an appendix epiploica The vermiform appendix was normal

CASE II—ZOPPRITZ (*Semaine Médicale*, No 6, April 21, 1909, p 192) Male, age twenty years This case of acute torsion verified and cured by operation, occurred in the service of Anschütz in Kiel

Three weeks before admission, the patient complained of moderate abdominal pain, of a cramp-like nature The onset of the illness was extremely sudden, with severe pain in the hypogastrium Temperature 38.2 No vomiting Pulse 96 The pain persisted It was most intense in the right half of the abdomen No dulness on percussion Tenderness over McBurney's point The diagnosis lay between acute appendicitis and acute cholecystitis Operation Right rectus incision Appendix normal The incision was lengthened A small discolored mass, moving with respiration, was found adherent to the omentum The adhesions were broken The mass, the size of a prune, was an appendix epiploica, taking origin from the transverse colon It was twisted 180 degrees It was removed Appendectomy Recovery

APPENDICES EPIPLOICÆ FOUND IN HERNIA

CASE I—RIEDEL (*Munch med Woch*, No 28, 1905, p 2308) Female, age fifty-six years For two years has had a right inguinal and a left femoral hernia Two days before admission, suffered severe pain in the left groin On examination, a right reducible hernia, left side, in femoral region an irreducible tumor, the size of a nut, hard consistence and almost painless to pressure

Immediate operation showed a femoral hernia In the sac, there was an appendix epiploica twisted once on its axis and adherent by its distal extremity It was 1 cm long, 2 mm thick and of a yellow color Necrosis had already begun The pedicle was ligated, the sero-appendix removed Radical cure Recovery

CASE II—RIEDEL (*Ibid*) Female, age twenty years, entered the hospital, August 14, 1905 For the past ten years, she has had a left reducible femoral hernia For the past few months, she has had a right irreducible femoral hernia The day before admission, the patient experienced a sharp, violent abdominal pain At the same time, the left femoral hernia became tender Operation disclosed, in

addition to a small amount of fluid, a fatty structure, 1 cm long and 5 mm thick, suspended to the wall of the sac by a thin pedicle of flesh fibrin Resection of the sac, and radical cure Recovery

CASE III—LORENZ (*Bericht-uber einen Seltenen Operations Befund, Wiener klin Woch*, vol xviii, p 1367) Female, age thirty-three years Complains of a right inguinal hernia, accompanied with general malaise, abdominal pain and complete stoppage of the passage of flatus Operation showed in the sac among the intestinal loops, a thin band, six cm long, starting from the meso-sigmoid and inserted into the neck of the sac Around this an appendix epiploica had passed, twisting itself 360 degrees It was strangulated Small flakes of fibrin were seen on the parietal and visceral peritoneum At the end of the twisted appendix epiploica there were subperitoneal effusions of blood The pedicle at the point of strangulation was gangrenous The band and the appendix epiploicæ were resected Radical cure Recovery

CASE IV—VON BRUNS (*Bruch einklemmung der Appendices epipl, Munchener med Woch*, Jan 2, 1906, p 16) Female, age fifty-five years Had a left inguinal hernia for four years This became painful and swollen and reduction was impossible On examination there was a hernia as large as an egg, the skin was red and oedematous No vomiting No distention, though obstipation existed Operation disclosed a sac filled with fluid and an appendix epiploica This was adherent by its base to the adjoining intestine which was slightly altered and presented a gangrenous aspect Removal of the appendix epiploica Inversion of the gangrenous spot and radical cure Recovery

CASE V—MUSCATELLO (*Bruch einklemmung der Appendices epipl und ihre folgen Munchener med Woch*, Sept 18, 1906) Female, age fifty-six years Two days before admission, and without apparent cause she experienced a violent pain in the left groin soon radiating toward the abdomen No vomiting and bowels moved Forty hours later she was brought to the hospital with a diagnosis of strangulated femoral hernia Examination revealed a swelling in the left femoral region, very tender, irreducible and not producing an impulse on coughing Operation under local anæsthesia revealed a sac containing yellowish fluid and two free bodies One measured 2 cm long and the other 1.5 cm long They were appendices epiploicæ attached to the sigmoid, by two fine pedicles, no torsion was present Removal of the appendices epiploicæ, resection of the sac, and radical cure Recovery

CASE VI—MUSCATELLO (*Ibid*) Male, age thirty-two years Six months previous to admission, he experienced a sharp pain in the left groin The pain disappeared for one month Then he noticed a small tumor which has gradually increased in size An examination revealed an inguinal hernia extending into the scrotum At operation, the omentum was found in the sac, in addition, there was an appendix epiploica, adherent to the posterior part of the neck of the sac and twisted upon itself The torsion took place about 5 mm from the insertion of the appendix epiploica on the colon A second appendix epiploica was adherent 5 mm below the neck of the sac Removal of the appendices and radical cure Recovery

CASE VII—MOHR (*Bruchhinklemmung von App epipl*, *Munch med Woch*, 1907, vol liv, p 170) Male, age sixty-two years He had for the past three or four years a small tumor in the left inguinal region Tumor reducible Ten days before admission, the hernia became irreducible The diagnosis was strangulated hernia and operation performed In the sac was found, attached to the posterior wall, an appendix epiploica which presented signs of hemorrhagic suffusion In addition, there were two other appendices epiploicæ which sprang from the sigmoid and which were in a state of torsion with gangrene imminent Removal of the three appendices epiploicæ and radical cure Recovery

CASE VIII—KRUGER (*Zur Torsion der App epipl*, *ibid*, 1907, vol liv, p 1813) Male, age fifty-six years Twenty years ago, he suffered from a pain in the right groin Two years ago, the pain returned only to disappear in a short while Three days before admission, he had a third crisis The pain radiated to the umbilicus On examination, there was a firm mass in the right inguinal region Operation disclosed, lying in the sac, an appendix epiploica 4 cm long and 1.5 cm thick It was inserted by a short pedicle to the cæcum which was in the sac The appendix epiploica was twisted upon itself and it was this torsion which gave rise to the inflammatory symptoms Removal of the appendix epiploica, and radical cure Recovery

CASE IX—SERVE *Isoherte Bruchhinklemmung einer Appen epipl Deutsch Militarärzth Ztschr* Nov 1906) Male For many years has had a left inguinal hernia, the size of an egg Two days before admission, he experienced, following a severe muscular effort, a violent pain in the hernia At the time of admission the scrotum was swollen, the abdomen distended, though the bowels moved When the sac was opened, a few drops of fluid escaped The sac contained an appendix epiploica 10 cm long, it was completely twisted upon itself Removal of the appendix epiploica and a radical cure Recovery

CASE X—VULLIET (*Du Rôle des appendices epiploicus dans les accidents herniaires La Semaine Médicale*, No 27, 1907, p 316) Male, age sixty-two years Has had two small inguinal hernias for twenty years Three days before admission, he had a pain in the left inguinal region One day before admission there developed a painful cord-like swelling which gradually increased in size The sac when opened contained two appendices epiploicæ, quite fatty and not adherent to the sac The pedicles were thin and extended to the sigmoid which lay immediately above the internal inguinal ring Removal of the appendices epiploicæ and radical cure Recovery

CASE XI—KENDERJY and SEJOURNET (*Revue de Chirurgie*, No 42, 1910, p 40) Male, age forty-three years Presents a painful swelling in the left inguinal region with symptoms of intestinal obstruction The diagnosis was strangulated hernia The history was that the patient had had this hernia twelve years It had never been completely reducible Incarceration or strangulation had never occurred The only symptom was a slight pain which would disappear quickly following a rest Always constipated Two weeks before admission the patient had a severe pain in the hernia which began to swell These

symptoms disappeared with a saline. Two days before admission symptoms of intestinal obstruction were noted. Purgation and enemas were ineffectual. Pain and swelling took place in the hernia. Examination showed a mass in the left inguinal region. The inferior end of the mass entered the scrotum. The skin was inflamed. Tenderness. Incision revealed a cylindrical sac, about 10 cm long and 6-7 cm broad. When the sac was opened, some yellow fluid escaped. A yellow mass was found in the sac. This had a fatty aspect and presented ecchymotic areas. The operator thought it was the omentum strangulated. Close inspection and traction on the mass brought into the wound, the intra-abdominal pedicle, which, in turn, was attached to the sigmoid. The torsion was one and one-half times. The pedicle was ligated 5 mm from the intestine and the appendix epiploica removed. Radical cure. Recovery.

CASE XII—SMOLER (*Über einen Fall von intra-abdominaler Netztorsion bei gleichzeitiger Brucheingklemmung einer Appendix epiploica*) Male, age thirty-seven years. Had for many years a right inguinal hernia, always symptomless. Two days before admission to the hospital he complained of pain in the hernia which had become irreducible. Examination presented a patient in moderate shock. The abdomen was distended and rigid. There was a right inguinal hernia extending into the scrotum. It felt like an omental hernia. Operation: the sac was thickened. Omentum was found discolored with beginning necrosis. To the medial side of the internal ring was a structure, thick as the little finger, 2 cm long which close inspection revealed as an appendix epiploica. Because of the necrotic condition of the omentum the incision was enlarged and the abdomen opened. This disclosed the condition of torsion of the omentum to the degree of 360°. The portion of the omentum in the sac was not adherent, in fact, the point of adhesion was to parietal peritoneum in the region of the internal ring. The appendix epiploica belonged to the sigmoid, which was strongly drawn to the right side. The omentum was removed and the appendix epiploica ligated and removed. Abdominal closure. Radical cure. Death, from heart failure. Autopsy showed chronic nephritis.

CASE XIII—SCHWEINBURG (*Ein Fall von isolierter Inkarceration ungestielter Appendices epiploicæ*) Male, age forty-five years (*Wiener klin. Woch.*, Dec 13, 1906, p 1522). Has had left inguinal hernia for many years. Always easily reducible. Six days before admission hernia became irreducible during work. No pain or vomiting. Bowels regular until day before admission. Pain then occurred and hernia became tender. Sent to hospital for operation. Examination showed well built man with sound organs. A small painful left inguinal hernia. Tender. Overlying skin not discolored. Abdomen not tender. Palpation of hernia gave sensation of small strings, easily pushed around under the finger. Diagnosis of omental hernia incarcerated. Operation: the sac was thickened, contained only odorless fluid, three masses found, gave impression of appendices epiploicæ. The largest was 4 cm long, 1½ cm broad, the smallest was 2 cm long, ½ cm broad. All were hemorrhagic and thickened. They were pulled down



and the sigmoid seen which demonstrated the masses were appendices epiploicæ Removal Radical cure Recovery

CASE XIV—LINKENFELD (*Deutsch Zeitschr fur Chirurgie*, vol xc, fas 4-6, 1908, pp 383-394 ) Female, age fifty-seven years Eight days before admission she noticed a swelling in the right inguinal region Severe pain, no vomiting, bowels regular Physical examination showed no abnormalities save a right inguinal hernia This was tender and dull on percussion Abdomen soft and not distended At operation an incarcerated piece of fatty tissue with a smooth surface was found adherent to the sac wall The adhesion was freed and the fatty mass pulled upon It showed a superficial creasing Removal of fatty mass Found to be an appendix epiploica, probably from the cæcum Radical cure Recovery

CASE XV—LINKENFELD (*Ibid* ) Case II, male, aged seventy-one years Many years had a hernia Past two weeks, pain, swelling and redness of the skin No symptoms of obstruction Taxis failed Examination Arteries sclerosed, intermittent pulse Left side hernia, size of fist Sensitive Skin is red Percussion dull Abdomen soft, not sensitive Passes flatus and stool No vomiting Operation (Braun) Sac chronically inflamed Three appendices epiploicæ found One thick as finger, other as pencil All swollen, red and hemorrhagic Upper end of these were creased Ligation and removal Radical cure Death on second day from acute dilatation of heart Autopsy, a dissecting aneurism of internal and external iliac arteries Large retroperitoneal hemorrhage Appendices epiploicæ of descending colon are greatly enlarged Two are united at the distal end So that with intestine they form an opening, through which one could put the index finger Also found an appendix epiploica discolored, filled with blood This must have been in the hernial sac and then became incarcerated The appendices epiploicæ of the sigmoid measured 15 cm

CASE XVI—LINKENFELD (*Ibid* ) Case III, male, age sixty-four years Very corpulent For eight days, a swelling in right inguinal region irreducible Painful No intestinal disturbance No vomiting Bowels regular Egg size swelling in right inguinal region and scrotum Consistence hard Diagnosis, incarcerated omental hernia Sac opened, had apparently a piece of omentum, adherent and fastened to the wall of the sac Piece of twisted connective tissue ran into the abdomen Removal of the so-called omentum Radical cure 48 hours later, vomited black-brown mass in which is blood Vomiting repeated the next day On the sixth postoperative day, sudden vomiting of pure blood Blood from bowel Death Autopsy Operation wound is perfect Blood in stomach and duodenum Multiple ulcers of stomach Six large fat and thick appendices epiploicæ on sigmoid The longest, 14 cm long One of the appendices epiploicæ had a stump 1½ cm long and had a ligature

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# ULTIMATE RESULTS FOLLOWING NEPHROPEXY IN CASES OF SYMPTOMATIC NEPHROPTOSIS<sup>1</sup>

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AND

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KNOWLEDGE concerning the anatomy of organs obtained at autopsy and in the dissecting room has within recent years led to serious errors in symptomatic deductions made in office or bedside studies. Before Schultze began his investigation of the anatomy of the pelvic organs in living women, the view generally held by anatomists was that the uterus normally occupied a retroposed position. This belief was due to the fact that after death the general relaxation of the supporting ligamentary structures permits the uterus to fall backward. Schultze, through the bimanual method of pelvic examination in a series of normal women, was able to prove the contrary position *in vivo*.

Before Glenard published his epoch-making paper in 1885, autopsy protocols seldom recorded the kidney in any other than a fixed lumbar position. Even with wide range of mobility the kidney after death settles back into its lumbar fossa, and with the congealing of the suprarenal fat the organ is left more or less fixed in articulo mortis, and what was an abnormal position in life becomes a normal one in death. In both instances adherence to classic anatomic standards led to a confusion of theories as to the symptomatic manifestations of these organs, and, as a consequence, both organs have been subjected to gross surgical insults. In every instance in which some form of fixation operation has been devised to fit a certain anatomic pattern these errors have been vividly demonstrated.

From 1890 to 1900, when, through eager but ill-tempered enthusiasm, many surgeons began a most energetic operative propaganda in cases of nephroptosis, too often the chief indication for surgical intervention was the mere presence of a movable kidney in a neurotic woman. Since the majority of women who have movable or floating kidneys are thin-chested, the subjects of enteroptosis, and are poorly developed in many other directions—in other words, are physical defectives from birth—they furnish the worst possible operative risks so far as restoration to a normal standard of health is concerned. Because of this very injudicious selection of cases, in the earlier phases of this work the greatest opprobrium was cast upon all operations for nephroptosis. So long as the anatomic rule was followed and was sustained by a blanket symptomatology covering all possible phases of gastro-intestinal and neurotic disorders, the beneficial result attained was indeed slender, as the final surgical inventory proved. Like the old-fashioned shot-gun prescription, it was potentially harmful oftener than it was beneficial.

It is not surprising, therefore, that many surgeons who from the first

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had been conservatively skeptical became radically antagonistic to any further surgical activity in this field. The effects of such antipodal positions in medicine are usually salutary, for time tends to dampen the ardor of the enthusiast and holds in leash the pseudo-surgeon, while the judicious practitioner, who occupies a position midway between an irrational optimism and a stubborn pessimism, may take stock, as it were, and from a careful balancing of equations usually gathers valuable practical conclusions that are applicable to an occasional case.

In the study of our series of 50 cases the evolutionary limitations of operative indications as our own experience has grown has come from the recognition of our own failures in the neurotic type of women. That vast and prolific domain of neuroses and of gastro-intestinal functional deviations that previously furnished so large a number of cases has of recent years been excluded by all discerning surgeons, for the final demand is that the kidney itself must, through manifest symptoms directly referable to the organ, furnish the indication for an operation. In our series of cases we find that, during the earlier years covering a much smaller clinical service in the University Hospital, the proportionate number of nephropexies was much larger than with the present greatly increased departmental census. This numeric shrinkage during the last seventeen years is indicated by the following figures:

During the years 1900 to 1905 there were 1385 ward admissions, among this number 18 nephropexies occurred, between 1905 and 1910 there were 1765 admissions, with 15 operations, from 1910 to 1915 there were 2422 admissions, with only 17 operations. In other words, the figures show a steady diminution in the percentage of elective cases.

If one adheres to the rule that surgical intervention is indicated only when the kidney or the bladder gives expression to symptoms, the ratio of cures will compare satisfactorily with that following other approved operative procedures. To define our attitude I may say that we have settled upon three cardinal indications for possible surgical intervention in movable or floating kidneys. These are *fixed pain in the renal area*, *Dietl's crisis*, and *marked vesical distress referred from the renal area*. Even these symptoms, however clear, must be supplemented and confirmed by a rigid clinical investigation, which should include a cystoscopic examination, catheterization of the ureter on the affected side, and, in the majority of cases, an injection of thorium and an X-ray examination to ascertain the degree of dilatation of the renal pelvis. Any apparent surgical indication not confirmed by these latter diagnostic measures is, in our opinion, open to criticism.

Every possible source of obstruction from lesions of the pelvic organs and from ureteral stricture must be excluded, and when these conditions have been fully complied with and an accurately defined bill of clinical particulars has been established, one is warranted in anticipating, with considerable optimism, a favorable outcome from a properly executed nephropexy.

## ULTIMATE RESULTS FOLLOWING NEPHROPEXY

In no case is the diagnosis of symptomatic nephroptosis permissible unless a thorough cystoscopic and skiagraphic study of the case has been made. Such a procedure is necessary not only because it affords additional evidence on which to base the diagnosis, but also because it eliminates the possibility of a renal lesion, such as calculus or tuberculosis, or of an ureteral stricture being present, which conditions may produce symptoms closely simulating those of movable kidney.

As a means of corroborating the diagnosis, pyelography has proved a valuable aid. In the more advanced cases of pelvic dilatation retention can be demonstrated by the ureteral catheter, but dependence should not be placed upon this alone, or erroneous conclusions may be the result. The picture of the renal pelvis and ureter shown in the pyelogram affords indisputable evidence, and often furnishes information concerning other lesions that would escape detection by simpler methods of diagnosis. By pyelograph it is possible to demonstrate not only the earliest stages of pelvic dilatation, but also the point of angulation which is often found to exist in the upper portion of the ureter or at the ureteropelvic junction.

My associate, Dr. Floyd E. Keene, who has charge of the cystoscopic investigations in our department at the University Hospital, has until recently used a 10 per cent collargol solution for the injections, with satisfactory results, more recently, however, he has employed thorium nitrate method, as described by Burns, and has found it superior to collargol in that it gives a clearer picture, is a cleaner medium to work with, and is apparently free from the dangers that have been reported as following the collargol injection. The ureteral catheter is passed into the renal pelvis, and the character of the urinary flow is noted, to determine the presence and the degree of retention. The catheter is then withdrawn for 15 centimetres, and with the patient in the half-sitting posture, the thorium solution is injected slowly by the gravity method. When the solution ceases to flow or the patient experiences the slightest sensation of fullness in the kidney region, the injection should be discontinued and the picture taken. By this limitation of the symptomatology and the accurate checking up of anatomic defects neuroses of all types and cases of gastro-intestinal disturbances are excluded.

The advances made in the surgery of the upper abdomen have in large measure exploded the pelvic reflex fallacies, for it has been amply proved that lesions of the pelvic organs that do not manifest direct symptoms seldom indeed give rise to gastric reflexes. This is true also of gastro-intestinal reflexes of renal origin. Because of the close anatomic relationship between the right kidney, the duodenum, and the pylorus, it is probable that an unduly movable kidney may occasionally be responsible for gastric disturbance. This statement is borne out by the occasional cure of these disorders that follows an operation for nephroptosis with a direct renal symptomatology. On the contrary, however, when the digestive disturbances are the sole symptoms, but few patients are cured by anchorage of a movable kidney. The occasional issue in which the gastric symptoms have been made the

pretext for an operation is so rare, and the record of failures is so frequent, as to strengthen the conviction that such disorders should never, alone, serve as a surgical finger-board merely because a palpable movable kidney is present. By following this policy of absolute limitation we may fail to cure an occasional deserving dyspeptic, but, on the other hand, we will also certainly escape the ridicule and just criticism of the internist or neurologist because of many surgical wrecks in which proper discrimination was not made. For years we have measured the range of the renal mobility in all abdominal sections by slipping the kidney under direct touch to its lowest point of excursus, and we have found repeatedly the most extreme mobility of the right kidney without a single attendant renal or gastric symptom.

Notwithstanding the more rigid selection of cases within recent years, we find, on reviewing the results, that the percentage of cures among the cases traced appears to be about the same. This at first sight is apparently at variance with the belief that a more rigid selective policy will yield better results. We believe that this uniformity of cures in our cases, however, is more apparent than real, and is due to the fact that a large percentage of women whom we have failed to trace were operated upon in the earlier days of our hospital service, when we were less discriminating in our surgical endeavors.

One cause of failure to effect a cure by nephropexy in a symptomatic nephroptosis may occur when there is chronic dilatation of the renal pelvis, with secondary renal changes, such as pyelitis or nephritis, and even though, as the result of the operation the kidney is placed in a better functioning position, the pathologic changes are too far advanced to permit a perfect physiologic restoration to take place.

As to the method of operation, we have found Edebohls's plan, with slight technical modifications, to be the most satisfactory. In our earlier series of cases we employed the Brodel stitch successfully, but we were always under the impression that in sinking a triangular stitch into the renal substance we increased the hazard of an untoward operative result.

In operating according to Edebohls's plan the usual straight dorsal incision is made, and the kidney is reached through the renal triangle, with a minimal amount of injury to the muscular structures. Great care must be exercised to avoid injury or ligation of the lumbar nerves. In one or two instances in our earlier experience this latter accident occurred, and a slow and painful convalescence was the result, in one case this distressing sequel dragged painfully on into months. The perirenal envelope is pulled well up and any redundancy is excised so that when the suspension stitches are applied this tissue also secures the kidney through its hammock-like adjustment. In effecting decapsulation of the kidney we depart from the extensive method of Edebohls. Our right plan is to split the capsule back on a grooved director to each pole of the kidney, but it is only slightly dissected loose from the organ, leaving a narrow band of exposed kidney substance about one-half inch wide. The extent of the decapsulation has thus been limited because experimental investigations and clinical experience have proved that the

fibrous capsule that reforms after a total decapsulation is frequently the source of serious pathologic changes. Three mattress sutures of silk or linen thread are inserted in the capsule on each side of the exposed dorsal surface of the kidney, and the perirenal fascial hammock, which is pulled up snugly about the kidney, is transfixed. With a long curved needle these sutures are carried through the lumbar wall to the surface and tied over small gauze bolsters. Because of the tension upon these sutures the denuded renal surface is brought up into snug contact with the incision, thus creating a strong bond of fixation between these two surfaces, where adhesions occur. The incision is closed in the usual manner, and at the end of ten days the suspension sutures are removed.

About 50 per cent of our cases have been examined at intervals varying from one to ten years after the operation, and in no case has a recurrence taken place. In one of our earlier cases in which a nephropexy was attempted by using the Biodel stitch, the hemorrhage from one of the triangular stitches in the kidney was so severe that a nephrectomy was necessary to save the patient's life. This was the only immediate surgical complication of noteworthy importance occurring in this series of cases. One patient died of a pulmonary embolus ten days after operation. From what has been said it will be seen that the dangers of a nephropexy are slight and should not deter the surgeon from undertaking the operation provided his intervention is based upon a valid renal symptomatology.

*Analysis of Fifty Cases of Nephroptosis in which Nephropexy has been Performed*—In following up the cases which have been operated upon between 1900 and 1915 we have been able to secure full data from 36 of the 50 cases operated upon during this time. Divided into five-year epochs, at first glance it would appear that the percentage of cures is about the same in all three groups regardless of the greater refinement of diagnosis and the more accurate restriction of the symptomatology to actual renal or vesical manifestations in the later series. This conclusion, however, is fallacious, for much the larger proportion of untraced cases falls within the first and second five-year periods than in the last. Thus, in 18 of the first group, only 10 could be located, of the second 15 there were 11, and in the last 17 there were 14. As we review the first and second groups, we observe, first, that the indications for operations were at times at best rather vague, and not infrequently the nephropexy was performed as an incidental part of a combined operation, consisting of various pelvic, appendiceal, and other procedures. Since 1910 the operations have largely been for the correction of a pathologic nephroptosis *per se*, and the only additional operation has been as a rule the coincident removal of an appendix as a matter of precaution rather than of necessity. We may, therefore, attribute a curative ratio of 70 per cent in this group directly to the kidney suspension rather than to some one of three or four other coincident operations.

In other words, one might say that in our earlier experiences, a nephropexy was thrown in with the pelvic operations on the principle of giving good measure rather than because the kidney was the subject of direct

pathologic manifestations In several of our earlier cures we may feel reasonably sure that this additional operation did neither harm nor good, whereas in some of our failures we are inclined to feel that the prolonged surgical manipulation in a neurotic individual has done positive harm We particularly are impressed with this fact in the final summary of results It is always salutary to review the bad results of our work in order to correct such faults in the future and to lay down fixed rules for a routine procedure applicable to a chosen group of cases

First, as an example of a surgical error, I would cite Case 810, admitted to the hospital in 1903 The patient's chief symptoms were—sharp pains in both ovarian regions, radiating down the left leg, headache, backache, no renal symptoms The examination revealed a prolapsed left ovary, prolapsus uteri partialis, lacerated cervix and perineum, and movable right kidney For these conditions the following operations were performed Repair of cervix and perineum, suspension of uterus, and right nephrorrhaphy This case could not be traced, but regardless of the result so far as any benefit to the patient's health was concerned, in the light of our present knowledge one may feel assured that no benefit was derived from the additional nephrorrhaphy In other words, this part of our operation was performed to meet an anatomic rather than a pathologic indication In such an instance if a bad result were to follow, the ill-chosen operation might easily have to bear the burden of a bad recovery According to our present attitude we view such a procedure as meddlesome surgery much more likely to be provocative of harm than of good

Our table of earlier cases reveals instances of misapplied surgery, but we believe that errors have been less and less frequent during the last ten years An operation without a clearly defined indication in a neurotic patient can only result in an untoward issue in the vast majority of cases, and it is for this very reason that we so urgently condemn the application of surgery to any organ unless a pathologic state directly amenable to surgical measures is found

We shall relate the brief summary of one more case of misapplied operation before passing to our later series which stands upon a more equitable basis Case 1230, admitted May 9, 1904 Chief symptoms were pain in lower abdomen, especially in inguinal regions and right renal area, increasing weakness, general nervous breakdown, seven or eight years ago Diagnosis Bilateral hydrosalpinx and right nephroptosis The combined operation consisted of a right salpingo-oophorectomy, left salpingectomy, partial left oophorectomy, appendectomy and right nephropexy Again, in this instance, the patient could not be located, but we do not hesitate to hazard the opinion that whatever the ultimate outcome in this case may have been the nephropexy added no beneficial effect but possibly helped to topple the patient further over into the domain of chronic neurasthenia We may refer to such cases as markers in the line of surgical progression, teaching the unerring lesson of what not to do

In the evolution of this phase of surgery these cases stand as

# ULTIMATE RESULTS FOLLOWING NEPHROPEXY

## CASES OF NEPHROPTOSIS OPERATED UPON DURING THE LAST FIVE YEARS

Gynecological number, date of admission	Symptoms	Diagnosis	Operation	Condition on discharge	Result
3462 10-6-10	Constipation, flatulence Colicky pains in lower abdomen Lump in right side of abdomen "Knife-like" pain in kidney Cannot lie on left side Nausea when on her feet	Right hydronephrosis from nephroptosis	Suspension of right kidney Appendectomy	Surgical convalescence satisfactory	Growing better each day Doing housework and gaining strength Gained 12 pounds Numbness in right hip Never sick except occasional headache
2510 11-2-10	Backache Frequency and urgency of urination Pain in side	Right nephroptosis Retroflexion of uterus	Appendectomy Suspension right kidney and ovary Coffey suspension	Surgical convalescence satisfactory	Greatly improved Constant desire to void has passed Pains across back, especially morning, but wears off later in the day Worse at periods
3518 11-10-10	Paroxysmal pain left side following pregnancy, relieved by voiding Mass in left side during attacks	Movable left kidney	Suspension left kidney	Surgical convalescence satisfactory	Could not be located.
3746 5-20-11	Pain in sacral region Weakness Easily tired Frequency of urination	Nephroptosis Peri-appendicitis	Suspension of kidney Appendectomy	Died suddenly from pulmonary embolus 10 days after operation	
3806 7-3-11	Pain in left kidney, radiating to bladder Slight hæmaturia after attacks	Hydronephrosis, due to aberrant artery Nephroptosis	Pyelotomy Nephropexy	Surgical convalescence satisfactory	Complete cure No urinary trouble except 2 attacks of cystitis Does not gain in weight
4130 3-21-12	Attacks of "indigestion" Pain in right iliac fossa Urinary frequency Flatulence	Chronic appendicitis Movable right kidney	Appendectomy Suspension right kidney (Edebohls)	Surgical convalescence satisfactory	Cured
4161 4-13-12	Lump in right side since a fall, 1 year ago Tenderness in both regions	Right nephroptosis	Nephropexy	Surgical convalescence satisfactory	Cured Slight œdema of feet since 1 year after operation Headache at periods
4308 8-20-12	Hæmaturia Pain right side Nausea Nervousness Menorrhagia	Hæmaturia Uterine fibroids	Supravaginal hysterectomy Suspension right kidney	Surgical convalescence satisfactory	Patient better and stronger in every way Tires easily
4582 2-12-13	Nausea after meals Epigastric distress	Cholelithiasis Movable kidney	Nephropexy Removal of gall-stones	Surgical convalescence satisfactory	"Intestinal trouble" and occasionally frequency of urination More or less nervous—due to onset of menopause
4692½ 5-13-13	Pain and soreness in right iliac region and loin Nausea and vomiting Frequent urination Epigastric distress after eating	Chronic appendicitis Cæcum mobile Movable right kidney	Appendectomy Suspension right kidney	Pain in kidney region	One year ago pain left side, lasting 4 weeks, diagnosed congestion of kidney Last summer attack of pain right side with fever, lasting 12 days, diagnosed gall-stones Occipital headaches with nausea and vomiting Nocturia but not as much as before operation Gained 14 pounds



## CLARK AND BLOCK

CASES OF NEPHROPTOSIS OPERATED UPON DURING THE LAST FIVE YEARS—*Continued*

Gynecological number, date of admission	Symptoms	Diagnosis	Operation	Condition on discharge	Result
4920 10-17-13	Sharp pain, left costo vertebral angle, referred downward and forward, backache, frequency, pain and burning on urination	Ptosis of left kidney Perinephritis	Suspension left kidney Freeing of adhesions	Surgical convalescence satisfactory	Unimproved—says she is in constant pain Very garrulous concerning multiplicity of symptoms Extremely neurotic
5019 12-22-13	Constant pain in lumbar region, radiating downward Nervousness	Left hydronephrosis	Nephropexy	Backache	Patient felt better and backache was hardly perceptible until pregnancy 1 year ago Constant severe headaches during entire pregnancy Backache worse since confinement Also constipated, never having a natural movement
5108 2-12-14	Dragging pain in right side for 2 years, worse when standing	Right hydronephrosis	Edcbohl's nephropexy	Surgical convalescence satisfactory	Much improved but at times feels weak Pain in left side and back Menstruated twice each month for past 4 months
5509 11-17-14	Sharp pain right side of pelvis Frequent desire to urinate Pain intermittent and involving loin	Chronic appendicitis Floating kidney	Appendectomy Right nephropexy	Surgical convalescence satisfactory	No further sharp attacks of pain but occasionally pain on bending or twisting Excellent health generally except somewhat nervous
5698 2-17-15	Bladder irritability Pain lower abdomen	Movable kidney	Nephropexy	Surgical convalescence satisfactory	Marked improvement
5751½ 4-21-15	Lumbar pain right side, 4 years Indigestion Dysmenorrhœa	Movable kidney	Nephropexy	Surgical convalescence satisfactory	Kidney excellent position Menorrhagia—seat of fibroid Rectal tenesmus at periods

milestones or perhaps turning points in our experience and have served a valuable purpose in limiting our endeavors to cases which offer a large percentage of curative possibilities with a minimum probability of untoward results and disastrous nervous sequelæ All too frequently we find still this same class of individuals being advised by physicians of limited experience to undergo these unnecessary, and therefore harmful operations, and quite as frequently surgeons who are willing to act as aiders and abettors of this unwarranted procedure

The paramount value of an accurate follow-up system is to detect the great as well as the lesser flaws in surgical work, so that those who follow may not fall into similar error From our observations the one chief warning is clearly apparent—a nephropexy in a neurotic woman, unless the renal symptomatology is clearly defined, cannot be deprecated too urgently

In concluding, we append a table of cases operated upon since 1910, the period during which we have endeavored to select only those of a true pathologic nephroptosis A summary of symptoms with diagnosis,

operation, and ultimate results is given While the results are by no means perfect, they nevertheless present a 70 per cent restoration to active efficiency of the women operated upon, a degree of restoration which compares favorably with many other operations generally accepted by representative surgeons

*Conclusions* —1 The kidney, particularly the right, is not a fixed organ, and even an excessive range of mobility is no certain index of a reflex gastric or nervous disability unless direct renal symptoms referable to the kidney itself are present

2 The three cardinal symptoms of disturbed renal function are pain in the renal area, a urinary or Dietl's crisis, due to kinking of the ureter, or vesical irritability directly referable to the kidney of the affected side

3 No diagnosis should rest solely upon palpation of even an unduly movable kidney or upon a definite symptomatology unless this is confirmed by a cystoscopic examination, catheterization of the ureters, and a pyelograph to define the point of kinking in the ureter and the degree of dilatation of the renal pelvis

4 With this rigid method of exclusion and clear symptomatic definition the surgeon may confidently count upon securing 70 per cent of cures and from 10 to 15 per cent of improvements as the result of the operation

5 The dangers arising from the injection of radiographic substances into the renal pelvis are great if piston or excessive gravity pressure is employed during the injection With slight gravity pressure no untoward symptom has been observed in our series of cases

6 In our hands, the Edebohl's method, with slight modification, has proved satisfactory as a permanent means of anchorage

# CONGENITAL ELEVATION OF THE SCAPULA

(SPRENGEL'S DEFORMITY)

By JOHN FAIRBAIRN BINNIE, C M  
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BRADFORD and Lovett (*Orthopedic Surgery*, 3d ed, p 391) write "This condition is a somewhat unusual congenital deformity in which one scapula is raised in its relation to the thorax and clavicle and also to the opposite scapula. The scapula is not only raised, but generally so rotated that its lower angle approaches the spine. Scoliosis is likely to exist in connection with it, and in some cases asymmetry of the face and skull has been noted, the affection is rarely bilateral. One or more of the scapular muscles may be absent and bony anomalies are frequent. In one class of cases a bridge of bone connects the scapula and the vertebral column, in another class there is a long piece of bone projecting upward from the superior border of the scapula but not articulating with or attached to the vertebræ. In other cases there is no bony outgrowth and no deficiency of muscles. In some cases the projecting upper border of the scapula is so noticeable in its elevated position that it is mistaken for an exostosis." The foregoing may be taken as the type of description of Sprengel's deformity given in works on orthopedic surgery and as a correct representation of the usual conditions encountered.

One of the most complete dissertations on Sprengel's deformity is the thesis of A. T. Horwitz (*Am Jour Orthop Surg*, November, 1908). Horwitz finds that 25 per cent (34 cases) show a bony, fibrous, or cartilaginous attachment of the scapula to the vertebral column. Twenty-seven of these were bony. This usually runs from the superior median angle or the upper third of the median border to the transverse process of a cervical (fourth to seventh) vertebra. The osseous union is usually by means of a triangular-shaped bone whose base rests upon the scapula and whose apex upon the transverse process of the vertebra. Its union is either by means of cartilage at one or both ends or by direct bony growth without cartilaginous intervention.

Many theories have been advanced regarding the etiology of the accessory bone. Some (Rager) think the presence of the bone a mere accident in the deformity, others think the bony growth primary.

Fairbank (*British Jour Surg*, 1, 570) summarizes a series of 18 cases of congenital elevation of the scapula as follows:

"The sex of 8 was male, of 10 female. The right scapula was affected in 6 cases, the left in 9, while in 3 the deformity was bilateral. The scapula was anchored to the spine in 7 cases. In 2 of these, both scapulæ were fixed, in one by a bridge of bone on both sides, and in the other by bone on the right and fibrous tissue on the left. Scoliosis was present in 10. In at least 4 a wedge-shaped half-vertebra was present. In one of these, at the age

## CONGENITAL ELEVATION OF THE SCAPULA

of two years, there was no curve, but by six years a low dorsal curve toward or rather below the elevated scapula, and quite unconnected with the half-vertebra, had developed. In 5 the dorsal convexity was directed toward the raised shoulder, in 4 away from it, while in 1 case with an abrupt curve both scapulæ were elevated.

"Partial fusion of ribs was seen in 7 cases, one of these being open to doubt. An unmistakable cervical rib was present in 2 cases only. In 2 there was total suppression of one or more vertebræ, while in 4 cases, including the two just mentioned, there was present a half- or wedge-shaped vertebra. In 3 other cases the shortness of the neck made suppression of vertebræ more than probable, but the difficulties encountered in taking radiograms prevented a definite decision being arrived at. In 2 cases a projection or exostosis was present at the vertebral border of the scapula.

"With regard to other deformities present, 3 cases displayed torticollis, 2 of them having both scapulæ elevated. The radius was absent in 1, the pectoral muscles were imperfect in 2, and facial asymmetry was noted in 2, only one of which was associated with torticollis."

Walsham and Willet, quoted by Horwitz (I am using Horwitz's paper very freely), promulgate three hypotheses

- 1 That the bone was formed in connection with the vertebræ and afterward became ankylosed to the scapula.

- 2 That it was primarily scapular and later became fused to the spine.

- 3 That it was found independently both of spine and scapula.

These authors support their second hypothesis opining that the bridge of bone is an "abnormal development of the suprascapular epiphysis, which normally exists as a narrow bridge of bone along the posterior border of the scapula, and consequently as homologous to the suprascapular bone of some of the lower vertebrates" (*e g*, the frog). Minot thinks the scapula, as other structures, is developed in a sheet. This sheet is continuous with that of the vertebræ, and centres of ossification appearing between the two points, a continuous band of bone is formed. Horwitz naturally tends to Minot's views and writes, "A suprascapula, if we regard this overgrowth as such, would extend from the lower portion of the scapula, whereas this extends from the upper third, with a broad base of attachment." Some of the theories as to the causation of Sprengel's deformity are.

- 1 Intra-uterine pressure from lack of amniotic fluid (Sprengel, Bradford, etc.)

- 2 Malformation of scapula part of a general maldevelopment (Kirmisson)

- 3 Schlange Arrest of development due to amniotic adhesions

4. Exostoses and muscle contractions due to periostitis (Eulenberg)

- 5 The scapula is developed at a higher level than it maintains at birth. Retention of the fetal position is the cause of the deformity according to Chievitz.

- 6 Injury at time of birth as has been demonstrated in torticollis (Gold-

thwart) Contraction of sternomastoid (Kayser), defective rhomboids (Lameris), defective pectorals (Schlessinger), defective trapezius (Kausch)

Horwitz accepts the theory of Rabel that the deformity is due to defective descent of the scapula

The case which is here reported presents some marked peculiarities

M T, aged four years

September 7, 1911 Two years ago fell out of bed, was found lying on her back A physician diagnosed fracture of the clavicle Her parents, unusually intelligent and watchful, had noted no peculiarities in her shoulder before the accident

At present patient suffers no pain but cannot raise the scapula A flat bony tumor reaches from the inner edge of the left scapula along the rhomboids to the spine and almost, if not quite, to the occiput, causing visible deformity The mass is firmly attached to the scapula, its upper edge is sharply defined on palpation, and can be grasped between the fingers

The scapular spine is much more vertical than is its fellow, the inferior angle of the scapula is displaced inward and upward The clavicle is intact Arm motion is normal The shoulder action is very defective, owing to the scapular immobility and deformity

X-ray shows the mass of bone separated by a clear line from the scapula (Fig 1)

On operation the upper part of the trapezius was split, exposing a flat bone united to the vertebral edge of the scapula by a layer of cartilage one-fourth inch wide The bone lay in a fibrous membrane identical with the periosteum The bone reached to near the occiput and one rounded corner of it extended just beyond the middle line of the back The bone and its cartilaginous connection with the scapula were excised as also the periosteum (Fig 2) The periosteum was sutured over the raw edge of the scapula (According to Quain the rhomboideus minor rises from the seventh cervical and first dorsal spines and the ligamentum nuchæ, to be inserted into the base of the scapula opposite the triangular surface at the commencement of the spine The rhomboideus major lies immediately below, being inserted into the vertebral edge of the scapula between the spine and angle Variations, however, occur, *e g*, "an additional muscle has been observed running close and parallel to the upper border of the minor from the scapula to the occipital bone, and has been called the rhomboideus occipitalis after a similar muscle occurring in some animals")

The wound healed satisfactorily, but by March 16, 1912, there was recurrence of the trouble

April 4, 1912 There is a new formation of bone arising from the vertebral border of the scapula from its spine to its inferior angle and reaching to a point about one inch to the opposite side of the vertebræ This bone is in two pieces, both firmly attached to the scapula by cartilage (Fig 3) This bone was excised along with the muscle in which it lay Periosteum was sutured over the cut edge of the scapula Another mass of bone (Fig 3)  $1\frac{1}{2}$  inches long by  $\frac{1}{2}$ — $\frac{1}{2}$ , lay parallel

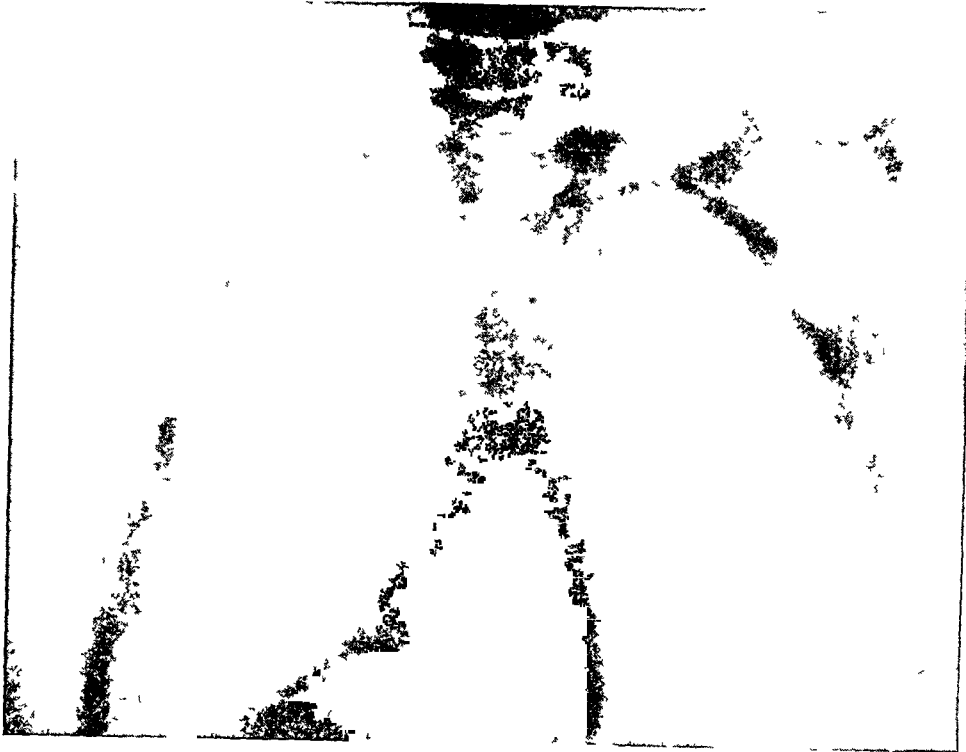


FIG 1

THIS POINT LAY  
AGAINST OCCIPUT



FIG 2



## CONGENITAL ELEVATION OF THE SCAPULA

and close to the spines of the vertebræ on the left side, but not attached to the bone lying in the rhomboideus major. This was also excised. A bony prominence was noted arising from about the angle of the first and second ribs, but this was not removed, as the patient was not taking the anæsthetic satisfactorily.

July 26, 1912. Almost perfect motion reported.

February 12, 1913. There is a prominence of the scapula on the left side anteriorly above the clavicle and nearly directly above the coracoid. The left shoulder droops and thus prevents complete abduction, otherwise shoulder motion is good. There is no recurrence of the bony neoplasm.

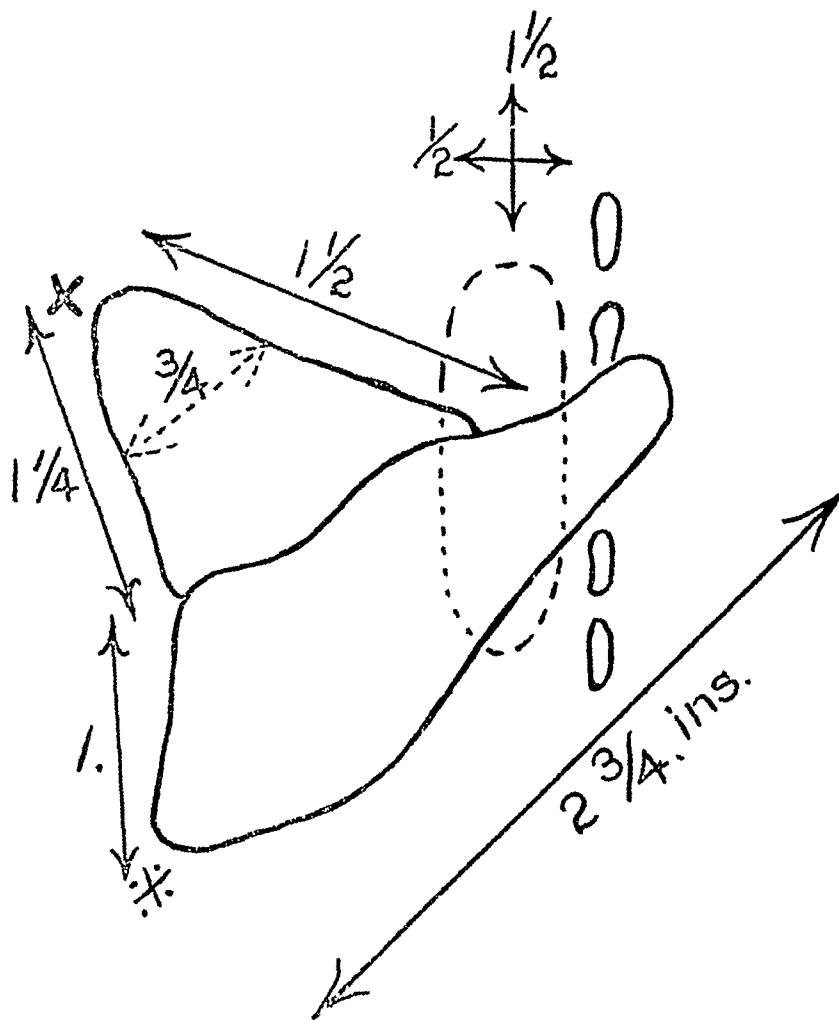


FIG. 3.—Diagram of bones removed at second operation. X, opposite spine scap. \*, opposite angle scap.

This case, so far as concerns the osseous new formations, corresponds closely if not precisely to cases of myositis ossificans, but it also corresponds to Sprengel's deformity. In view of the recurrence of the bony neoplasm after thorough removal one is led to the belief that the neoplasm is not congenital and not dependent upon Sprengel's deformity, but that the Sprengel deformity, *i.e.*, elevation of the scapula, may in some instances be dependent on the bony new formation.

The recurrent mass had wider attachments than the primary and involved fresh muscle. Also, there was the mass in the erector spinæ muscles which did not correspond with the typical findings in Sprengel's deformity.



# A NEW METHOD OF EXCISING THE HEAD OF THE HUMERUS<sup>\*</sup>

By T TURNER THOMAS

OF PHILADELPHIA

THE purpose of this paper is not to discuss the general subject of excisions of the shoulder-joint, but to report briefly what is believed to be a new operation and to report two cases on which it was done. By the operation which seems to be generally taught the upper end of the humerus is removed a variable distance below the tuberosities. All four of the rotator tendons, those of the supra- and infraspinatus, teres minor and subscapularis, are divided at their attachments to the tuberosities, their bony attachments removed and the long tendon of the biceps is dissected out of its groove in the humerus, to be later returned to what is left of this groove. The removal of so much bone and the detachment of so many important muscles lead to a serious disturbance of the function of the shoulder-joint, often to that very crippling condition, a flail shoulder. The operation offered here was performed on one case of recurrent dislocation of the shoulder and on one of old unreduced dislocation. It is, therefore, considered only in connection with these conditions. Any value it may have in connection with other conditions calling for excision of the shoulder-joint, such as tuberculous disease, must be determined later. It does not disturb any of the muscles except the subscapularis, which is divided, but later is reunited. Only the cartilage-covered portion of the humeral head is removed.

It is probably not generally appreciated that in the common anterior dislocation of the shoulder, recent and old, the only portion of the humerus protruding in front or outside of the glenoid cavity, is that covered with cartilage and not all of that. I have operated on between thirty and forty old dislocations of the shoulder, recurrent and old unreduced, in which I have nearly always found when I looked for it a typical groove of varying depth in the posterior part of the cartilage-covered portion of the humeral head. This resulted from the pressure against it of the anterior margin of the glenoid cavity, and the constancy of its presence and its situation shows just how much of the humeral head projects in front of the glenoid cavity in the ordinary dislocation of this joint. This groove corresponds to the site of contact between the two bones in the ordinary cadaver dislocation of this joint produced by hyperabduction. The removal, therefore, of the cartilage-covered portion of the head by sawing through at the anatomical neck will prevent recurrences of the dislocation, because it removes the only portion which can be dislocated, while it does not disturb any of the muscle attachments except that of the subscapularis which reunites closely later.

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<sup>\*</sup> Read before the Philadelphia Academy of Surgery, April 2, 1917

## EXCISING THE HEAD OF THE HUMERUS

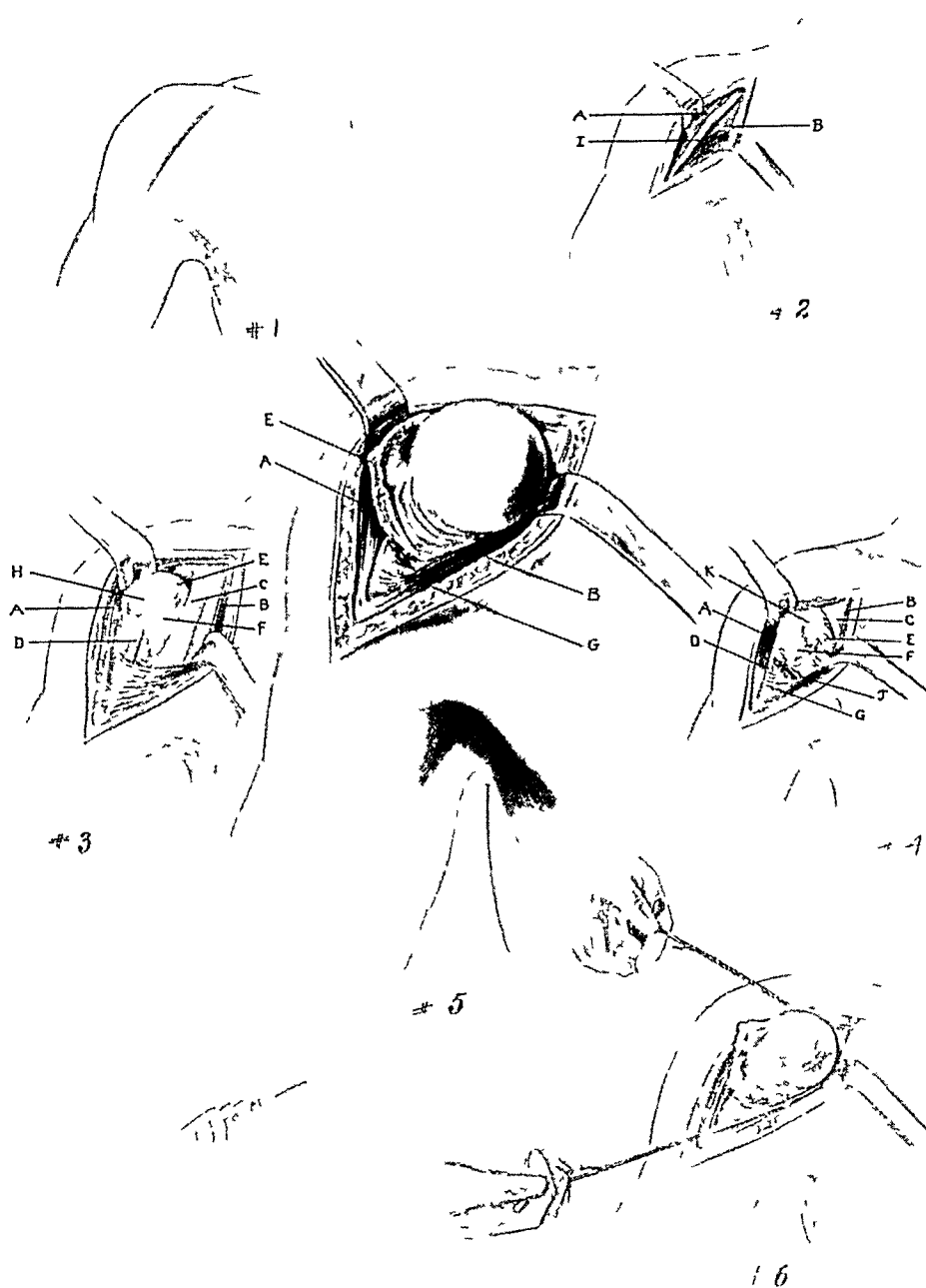
In the old unreduced dislocation this operation removes the bony obstruction to the ascent of the remaining portion of the humerus to its normal level just below the acromion process. But this ascent following the operation in my case was incomplete, probably because of the resistance of the surrounding soft structures which had grown into their abnormal position around the long dislocated head. It did, however, remove the bony resistance to movement, so that with increasing movement of the joint and use of this movement it is not unlikely that the humerus will later slowly work its way almost if not quite up to its normal level. In any case the result should be a better one than after removal of the humerus down to the surgical neck as in the usual excision of the shoulder. One can exclude the possibility of flail shoulder, but limitation of movement will be marked unless vigorous exercises are maintained for a long time afterwards. Very little effort was made in either of my two cases to obtain movement, in the epileptic because he did not greatly need it and because he would or could not keep up the exercises. In the other patient the hand of the affected side was helpless for the carrying out of the necessary exercises because he could not grasp anything with it. The degree of movement obtained in the first case, practically without effort, indicates that much better movement could have been obtained in a man who was determined to get it. The second patient was such a man but was crippled with an almost useless hand.

CASE I—Man, 26 years old, epileptic. Admitted to the Philadelphia General Hospital and the capsule operation for recurrent dislocation was done by myself, January 10, 1914. The dislocation recurred March 24, 1915, during an epileptic attack. He is a large and very powerful man and during such an attack it is said by the physicians who have been in charge that five or six men are necessary to hold him in order that he does no damage to himself or anybody else. During the fourteen months following the operation he had many convulsions without a dislocation. Soon after the operation he was removed to the insane department where he has remained since. I did a second capsule operation, September 20, 1915, and recurrence of the dislocation followed this on April 24, 1916, eight months later. In view of his great strength and violent convulsions and his failing mentality, because of which he will never be called upon to earn his living, it was considered advisable to excise the head of the humerus. This was done before the Clinical Congress of Surgeons, October 28, 1916, as follows.

The usual incision for excision of this joint was employed, *i e*, one about six inches long between the deltoid and pectoralis major from just above the coracoid process downward. After retracting the margins of the wound and exposing the upper end of the humerus the bicipital groove was located by palpation. The bony prominence in front of it is the lesser tuberosity and marks the insertion of the subscapularis. This tendon was divided parallel with the bicipital groove and about a half inch in front of or internal to it. This opened the

shoulder-joint and permitted external rotation beyond the normal limit. This tends to turn the humeral head out of the wound, the degree to which this can be accomplished depending upon the extent of the division of the subscapularis tendon and underlying capsule upward and downward. That shown in Fig 5 was obtained in the cadaver but not in operation on my patient. Enough was obtained in both cases, however, to make passing of the Gigli saw around the head at the anatomical neck comparatively easy, so that no difficulty was experienced in removing the head. In both, strong external rotation tended to tear the attachment of the capsule and tendon, after the cutting had been carried as far as could be seen, and thus to increase the external rotation and turning out of the head. The internal rotation of the Velpeau position, in which the limb was afterward dressed, brought the cut margins of the subscapularis tendon together without sutures, which may be used if desired. The skin wound was closed by plain catgut without drainage. The patient has had no dislocations since the operation although he has had many of his usual powerful epileptic convulsions. He seems to have full use of the limb except for the limitation of movement shown in Fig 7.

CASE II—Well-nourished, heavily-built man, 64 years old, fell down a flight of stairs on July 15, 1915, sustaining a painful injury of the left shoulder. He went to work on the following day, but his hand became so numb that he was compelled to give it up and come home. The hand felt as if it was "asleep." The whole limb has been very helpless ever since. A dislocation of the shoulder was not discovered for some time after the accident and then it could not be reduced. He was admitted to the University Hospital, May 24, 1916, and I attempted reduction without operation, unsuccessfully. He refused another attempt by operation at this time, but returned to the hospital in the following November for this purpose. The middle finger and the terminal phalanx of the ring finger of the affected hand, had been amputated years ago, but the remaining fingers had good movement and perfect function. Since the injury to the shoulder, these fingers and the thumb have been useless because of stiffness and atrophy which involve the whole hand as well. The patient wears a glove on this hand constantly because of numbness and coldness in it. Operation was done November 10, 1916. After exposure of the dislocated humeral head by the same incision as in the preceding case, the subscapularis was located and divided in essentially the same way. Many attempts were then made to pull or pry the head into the socket, with the aid of retractors for pulling and chisels to lever the head in, but without success. Then after some effort the head was rotated out of the wound as in the preceding case and a similar portion removed by the Gigli saw. It was more difficult to rotate the head out than in Case I, but with a little persistence in careful cutting of the capsule and tendon above and below, especially below, where the circumflex vessels had to be avoided, with strong rotation on the forearm to tear what could not be divided, enough exposure of the head was obtained to permit the passing of the wire saw around the anatomical neck.



FIGS 1-6—A, deltoid, B, pectoralis major, C, short head of biceps and coracobrachialis, D, long head of biceps, E, subscapularis, F, lesser tuberosity, G, tendon of pectoralis major, H, greater tuberosity, I, cephalic vein, J, anterior circumflex vessels, K, line of division of subscapularis and capsule 1, skin incision, 2, cephalic vein in interval between deltoid and pectoralis major, 3, upper end of humerus exposed in almost full internal rotation, 4, humerus in full normal external rotation, dotted line indicates where subscapularis and underlying capsule are divided into joint, 5, division of subscapularis and capsule permitted abnormal external rotation and turning of humeral head out of wound, 6, application of Gigli saw

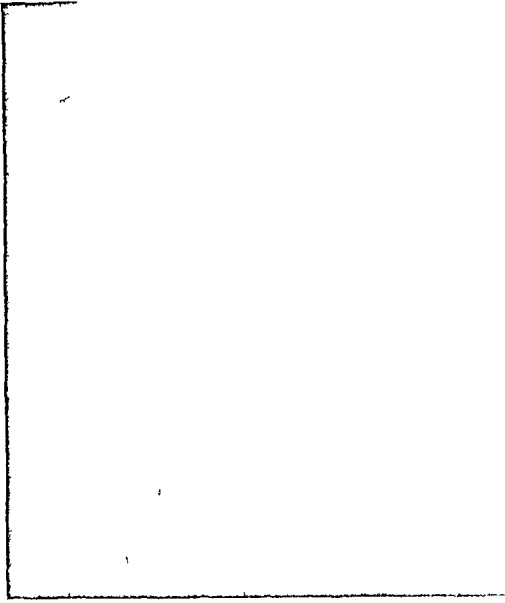


FIG 7—Case I Right shoulder after operation with arm in partial abduction and external rotation  
Line of excision could not be shown with arm at side and in internal rotation

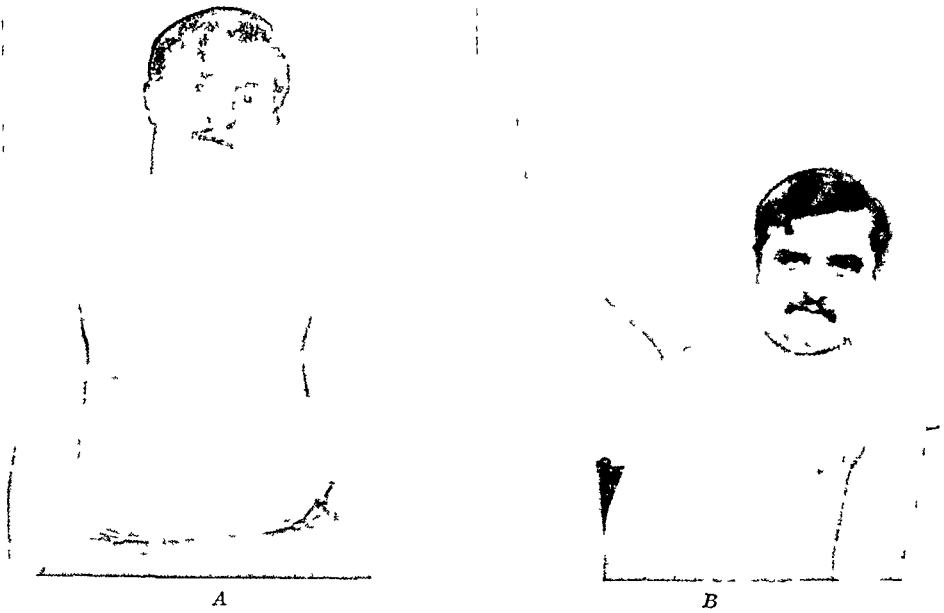


FIG 8—Case I A, showing nearly normal contour of right shoulder after operation B, showing degree of abduction now possible

## EXCISING THE HEAD OF THE HUMERUS

and then the working of the saw through the bone. No effort was made to force the head upward and backward to its normal level except by forcing the arm into full Velpeau position, and fixing it there. A small drainage opening was made into the axilla and a rubber tube introduced. There was no infection, but a hæmatoma developed in the inner part of the wound and was drained. The patient was discharged December 16, 1916, with a small sinus persisting. To-day, April 2, 1917, the tuberosities of the humerus operated on, on inspection and palpation, appear to have returned almost to their normal height under the acromion. Abduction can be corrected to a right angle with the body. External rotation is limited. The patient says the arm has been much more useful and comfortable "since the shoulder is back in place." The movements of the fingers, while still very limited, have shown distinct improvement since the operation.

# FUNGOUS DISEASES OF THE FOOT, OR MADURA FOOT, IN AMERICA<sup>1</sup>

By RANDOLPH WINSLOW, M D.  
OF BALTIMORE, MD

MADURA FOOT, or mycetoma, is a disease that has been known for many years as being endemic in certain localities in India, and as occurring occasionally in other parts of the world. A few cases also have been observed in America. This fungus disease is due to several varieties of vegetable growths, usually of the streptothrix family.

It occurs in three forms, the white or yellowish, the black, and the pink or red varieties. These varieties are so classified from the appearance of certain grains or particles that escape with the discharges from the sinuses that are found in the affected part. The most common form is the white or ochroid, next in frequency is the black or melanoid, and least frequent is the red or pink variety. The ochroid or white form of the disease when examined under the microscope shows fungi that resemble very closely the actinomyces, and it is probable that some, at least, of the reported cases are due to the ray fungus. In some of these cases, however, the granules resemble fish roe in appearance and are probably not due to the ray fungus. The granules from the melanoid or black differ very materially in appearance and characteristics from those of the ochroid form, being black in color like grains of gunpowder, and hard and resistant to pressure, while those from the ochroid variety are light in color, soft and easily crushed. Vincent succeeded in cultivating the fungus from a case of the white variety, and Wright was able to reproduce black masses from a case of the melanoid variety. From the observations of Wright and others it is evident that the ochroid and melanoid forms of the disease are not due to the same fungus or organism, the ochroid variety being due to a streptothrix, while the melanoid form is due to a more highly organized fungus or hyphomycete.

Clinically mycetoma is a chronic inflammatory condition, usually, but not invariably, affecting the tissues of the foot, in which the foot becomes much enlarged, with nodular masses that break down and form sinuses, from which a thin purulent fluid escapes. In this discharge are seen pale or black bodies which when examined microscopically reveal the nature of the affection.

As the disease occurs generally in tropical or subtropical countries, where the people are accustomed to go barefooted, there is often a history of some injury of the foot, such as the penetration of a thorn or splinter. The disease therefore usually begins on the sole of the foot as a small swelling, painless at first, but, as the condition progresses, becoming painful and interfering with locomotion. As the infection extends other nodules form and suppurate and cause fistulous tracts which open externally.

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<sup>1</sup>Read before the American Surgical Association, June 2, 1917

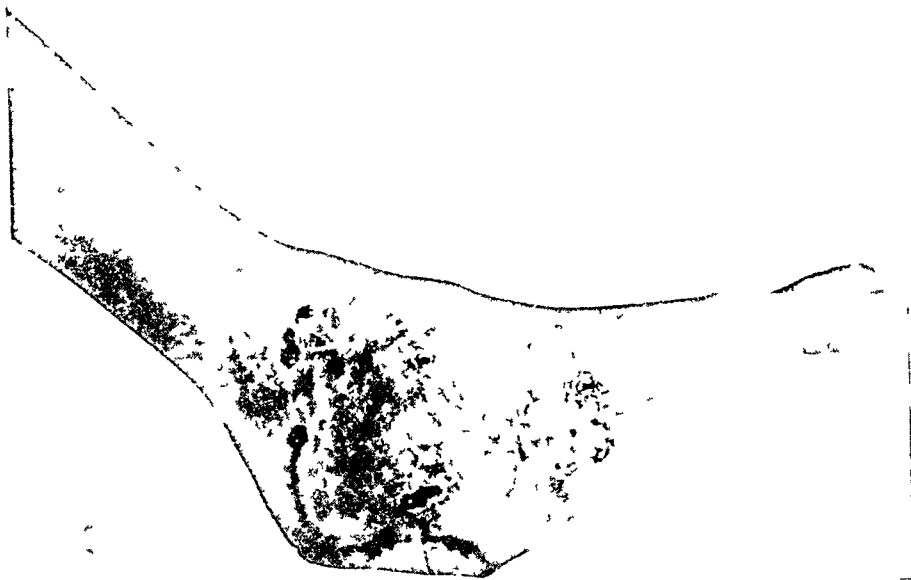


FIG 1 —Actinomycosis of foot— 'Madura foot "





Eventually the whole foot becomes much swollen, with a brawny, nodular induration, and with numerous fistulæ discharging a thin sero-pus containing the characteristic granules. The motions of the foot seem to be limited more by the inflammatory swelling of the soft parts than by destructive lesions of the bones, though a rarefying osteitis of the bones of the foot is also present. The disease never heals spontaneously but progresses slowly, without causing marked cachexia. Eventually however, it terminates fatally unless arrested by appropriate treatment.

The conditions for which mycetoma is most likely to be mistaken are tuberculosis and sarcoma. From the former it should be discriminated by its nodular masses and brawny infiltration and its absence of fever, from sarcoma by its chronicity, its hardness and the discharging sinuses, and from both by the characteristic granules found in the discharge from the fistulous tracts. It has also been mistaken for elephantiasis but its comparatively limited area and numerous sinuses should be sufficient to distinguish it from that affection.

As medical treatment is of no avail amputation above the seat of the disease is the only remedy.

Up to the present time only seven cases of mycetoma have been reported in the United States and Canada, six of these cases were of the ochroid form and only one of the melanoid. Three of these cases occurred in Mexicans living in Texas, one in a French Canadian who had always lived in Canada, one in a young man born in Iowa and one in a young woman living in Kansas. J. Homer Wright, of Boston, observed the only case of the black variety that has been reported in this country, which occurred in an Italian woman who had lived in America several years. From this case he succeeded in making cultures and in reproducing black sclerotia.

As a contribution to the literature of the subject I desire to place on record the following case of fungous disease of the foot, which clinically corresponds with the cases reported as examples of the ochroid form of madura foot.

On December 8, 1900, Wm. Johnson, colored, from Easton, Maryland, entered University Hospital, Baltimore, to be treated for an affection of the left foot and ankle and gave the following history. He is 29 years of age, unmarried, and works on a farm. His family history is unimportant. He has had measles but does not remember having had any other acute sickness. He had had gonorrhœa twice, and six years ago had a sore on his penis, followed by an eruption over his body with alopecia and pain in the limbs. He also has had a suppurating right inguinal adenitis. He uses alcohol in moderation, and both chews and smokes tobacco. About three years ago, while working on a farm, he cut his left foot with an ax. The wound was situated on the inner side of the instep, and was one inch in length and half an inch in depth. At the time of the injury he was wearing a pair of shoes that were covered with manure from the horse stables. He treated the wound himself for a while but, as it continued to get worse, he consulted a physician and it soon healed. About two

months later an abscess formed at some distance from the original wound, which opened and gave exit to a foul pus. This abscess healed and he had no further trouble until the next summer, when another gathering about as large as a silver dollar formed, which he opened with a razor letting out considerable pus. This sore never healed entirely but he continued working on the farm, ploughing and attending to horses. He did not have any pain in the foot except when he wore tight shoes. In January 1900, the foot began to swell and the joints became very stiff and a good deal of pain was felt. In February he had two sick horses under his care, both of which died. One horse had a lump under its jaw. He also cared for a sick cow in April, which likewise died. He had a sore on his foot while he was attending the sick animals but was wearing boots at the time, although he was accustomed to go barefooted when the weather was warm.

There were no other animals sick on the place where he worked, but on an adjoining farm three horses died, which he visited twice and administered medicine to. The man's symptoms increased in severity, the foot became greatly enlarged, and locomotion gradually became impossible. He entered the Maryland General Hospital in July and was advised to have the foot amputated. To which he would not consent. He, therefore, returned to his home, where he continued to get worse until he entered University Hospital in December.

On admission there was an extensive brawny swelling of the left foot, extending from the tarsometatarsal junction to above the ankle and involving the whole circumference of the foot. The skin was much indurated, and a very thin pus containing yellow particles exuded from, or could be pressed from, numerous sinuses upon the surface of the foot. A probe introduced into these sinuses did not penetrate deeply into the tissues. The motions of the foot were impaired but not obliterated, and he could impart some motion voluntarily. It appeared as if the lack of free motion was due to infiltration of the soft parts rather than to disease of the bones. No pain was felt when he kept still but when he bore weight on the foot it became painful. The glands in the groin were somewhat enlarged but not greatly so. The limb above the foot was thin but not markedly atrophied. His organs were healthy and temperature chart practically normal, as was also the urine. An examination of his blood showed leucocytes 11,800, red cells 4,400,000, hæmoglobin 80 per cent and a slight eosinophilia.

An examination of the granules from the sinuses revealed actinomyces in abundance, but no effort was made to differentiate the special type of streptothrix present. An amputation in the middle of the leg was performed and he made a speedy recovery.

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# TRANSACTIONS

## OF THE

# PHILADELPHIA ACADEMY OF SURGERY

*Stated Meeting, held April 2, 1917*

The President, DR CHARLES H FRAZIER, in the Chair

### RESULT OF TREPHINING FOR COMPOUND FRACTURE OF FRONTAL BONE

DR P G SKILLERN, JR, presented a man, aged thirty-five years, who was admitted to the Polyclinic Hospital, service of Professor G P Muller, on January 18, 1917, at 12 01 A M, and was discharged cured on January 27, 1917. Shortly before admission to hospital he was attacked by a man who struck him a blow upon the right side of the forehead with an ordinary hatchet. When admitted the patient was perfectly conscious and talkative, but somewhat under the influence of liquor. Physical examination revealed a vertical wound on right side of forehead three-quarters inch from median line and with its lower angle at the supra-orbital eminence, whence it extended upward one and one-quarter inches. Beneath the cut scalp edges the skull was laid open, the outer edge projecting forward, while the inner was depressed. Pulsations of the underlying dura were plainly visible. Dark blood flowed from the wound. Under ether anæsthesia and iodine preparation the wound was enlarged downward to the orbital margin, revealing extension of the line of fracture below the limits of the trauma wound. The outer table was bitten away with rongeur forceps, revealing more extensive splintering of the vitreous than of the outer lamina of the skull. Adjoining the deep margin of the hatchet cut these splintered vitreous fragments were depressed upon the dura, which was not, however, lacerated. To gain more room a horizontal incision was added, beginning at the lower angle of the vertical incision and extending two inches outward just above orbital margin and parallel with it. The fracture in its lower portion had opened the frontal sinus. All splinters of vitreous were removed. While withdrawing a splinter from the inner side of wound bleeding arose from the superior sagittal sinus, which was controlled by two strips of iodoform gauze packing, to prevent infection of meninges from nose. There was now a gap in the skull with rounded, even margins, the dura was still unopened. Over this gap the scalp was sutured lightly. Dr Skillern remarked that this case emphasized the importance of performing exploratory operations upon skull injuries. This patient when admitted was conscious and talkative in spite of the gaping wound made by the hatchet, and there was but a moderate amount of bleeding from the wound, yet the vitreous table was extensively shattered and depressed upon the dura. One of these vitreous splinters had penetrated the wall of the superior sagittal

sinus, it plugged the hole it had made in the sinus, as was shown by the profuse hemorrhage ensuing upon its removal under gentle manipulation. The opening of the frontal sinus developed a source of infection from the nasal cavity to the meninges. The advantages of the operation, therefore, were that it revealed the extent of injury, permitted relief from the pressure of the inner table upon the dura, prevented secondary hemorrhage from spontaneous dislodgement of the splinter which plugged the sagittal sinus, and facilitated disinfection of the frontal air space, which, although not harboring bacteria when not diseased, yet at operation must be considered diseased until proven healthy, and which, even when healthy, for a path for the transmission of infection from the nasal chamber to the meninges.

#### INTUSSUSCEPTION IN AN INFANT RESECTION RECOVERY

DR JOHN H. JOPSON presented an infant, aged seven months, who was admitted to the Children's Hospital May 12, 1916, being referred by Dr. A. G. Mitchell, with a diagnosis of intussusception. He was breast fed up until three months of age and then bottle fed on cow's milk mixture. He was well until thirty-six hours before admission, when after a bowel movement he developed colic followed by vomiting, and had continued to vomit everything taken, including milk, water and barley water. The vomitus was expelled with considerable force and was at first green and later somewhat brown, containing some mucus, but was not of a fecal odor. There had been no bowel movement since pain began, and no attempt to cause any by enema had been made. When first seen (by Dr. Mitchell shortly before admission) the child was quite sick. He had a strong cry, the skin was loose, showing evidence of rapid loss of weight and fluids. The throat, heart and lungs were normal. The abdomen was soft and scaphoid, not tender, and presented in the lower portion, median line below the umbilicus, a visible and palpable sausage-shaped tumor 2 inches by  $3\frac{1}{2}$  inches, apparently in the region of the small intestine. Rectal examination revealed no tumor, but blood and mucus were voided. There was no history of frequent bloody and mucus stools, the bowels being closed since the development of the pain and vomiting. This is significant in view of the operative findings.

On admission to the hospital the temperature was  $100\frac{3}{5}^{\circ}$ , pulse 152, respirations 38. Operation the same evening under ether anæsthesia. A right rectus incision downward from the umbilicus exposed an intussusception immediately beneath the wound, which when delivered was found to be entirely in the small intestine. The exact location was not sought for or determined. The peritoneum was smooth and shining over the bowel, the deeper layers of which were dark and congested. There was marked constriction at the upper end of the tumor, the entering point of the bowel. All attempts at reduction failed, the peritoneum splitting on slight pressure when attempts were made to express the bowel from below upward. Resection was at once performed, the mesentery being cut close to the edge of the intussusception and a small-sized Murphy button used to perform end-to-end anastomosis. The snug closure was then reinforced by the Cushing

suture, interrupted at one point. The abdominal wall was closed by through-and-through sutures of silkworm gut. The time of operation was forty minutes, and the condition on the table at times was poor, and strychnia and camphorated oil were used hypodermatically. After the operation proctoclysis with glucose and soda solution was used and small amounts of nourishment given by mouth the following day. The patient vomited at intervals for the first thirty-six hours, and there were several movements which contained blood, or mucus, or both, for forty-eight hours after operation. The movements became fecal on the second day, when several dark brown liquid stools were obtained, and the vomiting practically stopped. Attempts at feeding by peptonized milk were not very successful and it was later rendered possible to obtain breast milk from one of the wet nurses employed by the hospital, which agreed well with the infant. The temperature rose sharply after operation, as is usual in these cases, reaching  $105^{\circ}$ , and declined gradually, touching the normal in six days. The promising convalescence was suddenly interrupted by an accident which threatened for a time to result fatally. This complication was due to failure of union in the abdominal wound which opened up when dressed on the seventh day, and a couple of loops of small intestine protruded from the abdominal cavity. The child was taken to the operating room and given a little chloroform, the intestines replaced, a cigarette drain inserted in the peritoneal cavity, and the wound re-sutured. It healed thereafter by granulation. The button was passed on May 20. The child was transferred to the Medical Ward for treatment by Dr. Hand on June 4, where, with the aid of breast milk, the weight chart showed a steady gain, and the patient was later sent to the country branch of the hospital from whence he was discharged June 21.

The patient was readmitted to the medical wards in Dr. Hand's service in July, with symptoms of gastro-intestinal indigestion, marked by diarrhoea, vomiting and loss of weight. Improvement was prompt, and under proper feeding the child gained 2 pounds or more in the course of a month, when he was again discharged to his home as cured. At the time of his readmission the child weighed 10 pounds 3 ounces, and at the time of his discharge 12 pounds 4 ounces. This illness was apparently the ordinary gastro-intestinal disorder of the summer months.

The length of the entire specimen removed was 23 cm. measured along the border opposite the mesentery. Of this length 7 cm. was accounted for by the collapsed section of the ileum below the tumor, extending to the point of resection of the bowel. There was a short portion of ileum resected above the point of the entrances of the intussusciptions. The diameter of the intussusception was 9 cm. It will be seen from these measurements that between 15 and 18 inches of intestine were resected. The child, now eighteen months old, is in good condition and well nourished in spite of unhygienic surroundings and poor maternal care.

The case adds another recovery to the very small number of infants who have survived intestinal resection for irreducible intussusception. Dowd, writing in 1913, referred to eight cases besides his own remarkable

case of recovery in an infant five days old. Reference may be made to two other cases reported by J. Fraser and Clubbe, without attempting a complete review of recent literature. In view of the rarity of recovery after resection, one might consider with favor the practice of short-circuiting the bowel by an anastomosis around the irreducible intussusception as successfully practised in two cases in children by Rutherford and Parry. The present case also illustrates the value of the Murphy button for emergency work even in infants. In four of the previously reported recoveries, a Murphy button or Mayo Robson button was used. Twice the Paul tubes were used, for a two-stage operation. Dowd favors the use of needle and thread.

#### CHRONIC INTUSSUSCEPTION OF THE LARGE INTESTINE IN AN ADULT

DR. JOHN H. JOHNSON reported the history of a man, aged thirty-six years, who was admitted to the Presbyterian Hospital with a history of illness of two months' standing. It began as slight soreness below and to the left of the umbilicus and was associated with cramp-like pains in the same region, coming on about one hour after meals and also present and more intense at bed time. Vomiting began a few weeks previous to admission and matter vomited consisted of stomach contents and bile. Pain was not relieved by eating or medication. There was some relief from pain while lying upon the left side. The bowels at first were regular and later diarrhoea developed, sometimes eight or ten movements a day. The movements were usually greenish and liquid and never contained blood. Along with these symptoms he lost weight. When admitted abdominal distention was marked, the abdomen was tympanitic, with a tender area below and to the left of the umbilicus. No mass could be felt. The abdomen was very tense, so that examination was unsatisfactory and there was no evidence of fluid. The white blood count was 6250. The patient was not acutely ill on admission. Diarrhoea was still present. No diagnosis had been arrived at during the time the patient was in the hospital but he was undergoing a systematic examination and on the third day after admission and while being prepared for X-ray examination, he developed an unusually severe attack of abdominal pain, being an exaggeration of the same type of cramps to which he was subject. He went into collapse almost at once and died within a few hours and without any sign of reaction.

At autopsy there was found a chronic intussusception in the descending colon. Probably as a result of the chronic, incomplete obstruction, a perforation had occurred, not at the site of the intussusception, but in the first portion of the ascending colon. The abdomen was full of fecal contents and death was due to shock and peritonitis. When the intussusception was opened, there was found at the apex of the intussuscepted bowel what was at first thought to be a pedunculated growth. It was only on microscopic section of the same and after a study of several sections that Dr. Pfeiffer, pathologist to the hospital, pronounced this mass to be a portion of the parietal wall of the inverted bowel.

## LARGE FIBRONEUROMA OF THE MEDIAN NERVE

DR JOHN H JOPSON presented a male negro, aged forty-five years, who was admitted to the Bryn Mawr Hospital in January, 1917, with the history that about thirty years ago he had noted a small swelling on the inner side of the left arm following a slight traumatism, which gave him no pain and was not tender on pressure. It underwent a very gradual enlargement. He paid little attention to it until about three months ago, when he began to have pain in the arm and a stinging, tingling sensation in the ring and little fingers. The patient was an exceptionally well-developed and well-nourished negro, otherwise in good health. There was a large, hard, round, symmetrical tumor the size of a small fist on the inner side of the left arm overlying the vessels midway between the axilla and the elbow. It was slightly movable and lay to the inner side of the biceps muscle and apparently was not attached to it. It was not tender on pressure nor did examination cause any pain in the distribution.

At operation the outer portion, or what might be designated the capsule of the tumor, was found to be made up of many layers of what appeared to be smooth, fibrous tissue. The tumor was situated in the course of the median nerve which entered it at its upper and left it at its lower pole. Each layer of the above-mentioned capsule was split and dissected back with care to avoid injuring the nerve fibres. Examination showed that the fibres of the nerve spread out after reaching the growth, and when the innermost layer was divided the tumor could be peeled out entire without cross-sectioning any nerve tissue. The sac that remained bore very much the same relationship to the unaffected portion of the median nerve that the sac of an aneurism does to the artery after incision. The layers of the sac were then infolded so as to obliterate it, using small catgut sutures, and the arm was dressed upon a splint.

Following the operation the patient was found to have a loss of sensation on the palmar surface of the index and middle fingers and the first phalanx of the dorsal surface. There was also loss of flexion of the thumb and index finger. He was discharged from the hospital February 4, 1917.

When he reported for examination five weeks later there was a soft swelling four inches long and two inches wide in the site of the tumor. He has still what he describes as "a sore feeling" along the course of the median nerve from the elbow to three inches above the wrist. Anæsthesia persists on the flexor surfaces of the thumb and index finger, across the palm to a point about one inch above the base of the third finger, the palmar surface of which is also anæsthetic. The dorsal surface of the index and of the middle finger is affected as far as the first joint. There is a small area of anæsthesia on the radial side of the last phalanx of the fourth finger. Muscular power in the thumb is largely regained. There is still some loss of flexion of the proximal phalanx and flexion is lost in the index finger. The patient is receiving electrical treatment at the present time.

The pathological report of the tumor is as follows.

Microscopic examination of sections taken from the wall of the tumor shows a dense connective-tissue stroma which contains relatively few cells and has



undergone hyaline degeneration. The tissue is well vascularized and in a few places rather large blood-spaces are noted. There are areas in which lime salts have been deposited, minute areas containing blood pigment are seen, and considerable amounts of blood extravasation are present. Small foci of necrosis appear, these areas are found toward the innermost degenerated portion of the tumor. The major portion of the growth is composed of the dense fibrous stroma noted. Microscopic examination suggests a fibroma which has undergone the various degenerations noted.

This specimen represents a rare type of tumor, namely, a solitary neurofibroma of unusual size, originating from the endoneurium. Solitary neurofibromata of this type present the picture of a slowly-growing benign tumor which, according to Woolsey, not infrequently undergoes either myxomatous, cystic or fatty degeneration, and less commonly sarcomatous change. The multiple type of neurofibroma is more common than the solitary variety. Neurofibromata may reach the size of a grape fruit. They are sometimes hereditary, and more often congenital, the plexiform variety almost always so.

The appropriate treatment of endoneural tumor of the solitary type is incision of the enveloping nerve sheath along the course of the nerve fibres, carefully avoiding division of the same, until the adventitious capsule of the tumor is passed and the tumor itself is reached and can be enucleated. This was the procedure practised as far as possible in this case, but, as is evident, there was some disturbance of function of the nerve despite the care which was exercised. This condition is improving and if no recurrence of the tumor takes place, will probably be almost, if not entirely, overcome.

#### ULTIMATE RESULTS OF NEPHROPEXY

DRS JOHN G CLARK and FRANK B BLOCK read a paper with the above title, for which see page 479.

DR GEORGE ERETY SHOEMAKER said that one of the essential conditions in dealing with kidney prolapse is that the operation be undertaken for definite symptoms due to the kidney mobility and not because the kidney moves. Many of his patients had been treated satisfactorily with the corset alone. In several instances other operations have been done, for example, repair of lacerations or Coffey operation, but it has been possible in nearly all instances to separate symptoms due to the other conditions.

The operation has a somewhat limited place but a definite one, it will relieve certain very definite distress from dislocation of the kidney which produces in its aggravated form the Dietl's crisis and certain indefinable sensations of unrest which appear only in the upright position and which disappear with kidney support. The situation in life of some women prevents their wearing through the day an efficient corset.

In 1906 he published in the *Journal of the American Medical Association* a suggestion for the modification of the technic of kidney-fixation which was intended to be added to suture methods and all other methods of support which might be advised. It consists essentially in delivering the kidney as usual through the torn fascias and fatty capsule, then closing the opening

from which the kidney emerged by catgut sutures of the fat and fascia below. It will now be found that the kidney cannot be put back into the body, a new bed for it is made by blunt dissection close to the muscles of the back and above the incision, after which the usual method of suture of the kidney to the parietes is carried out and the external wound is closed. Where this technic can be carried out he believed that a better support is obtained and a better cushion of fat formed below the kidney. This does not interfere with any other technic, but is an addition to it.

He had notes on 21 cases of suspension of the kidney within the last seventeen years. Within the short time since receiving notice as to this discussion, he had been able to hear from and examine several of these and the condition of all except 5 is known. All recovered from the operation. One, performed seventeen years ago, is known to have relapsed; she, however, had a greatly relaxed and pendulous abdomen, has had 4 children since the operation. She was relieved of very severe attacks of dislocation with kidney prominence, extreme pain accompanied on one occasion by bloody urine, eleven years later there was but little descent of the kidney, but at present it has a large range of motion, although there are no crises.

One patient, with no other trouble, operated eleven years ago, writes "I have no discomfort, have since married, and have two children, and attribute present well-being to the operation."

Another examined a few days ago was operated in 1903 (fourteen years ago), she has had 3 children since, does more work than ever before and is "feeling splendid", present weight 145 pounds. Before operation the left kidney was below the navel, she had crises of abdominal pain usually produced by exertion, several attacks with a palpable lump over the kidney and severe pain. She was symptomatically cured and remains so to date. In this case part of the fatty capsule was removed.

Another extremely grateful patient has regained her health completely, but in addition to the kidney suspension she had a Coffey operation for viceroptosis. The right kidney was 2 inches below the navel. She has regained her health and capacity to work as a foreign missionary. She remains well, kidney was examined more than a year after fixation and found in good position.

In his general experience there has been little occasion to regret the operation largely because the cases have been selected. As far as known there has been only one absolute failure to secure improvement beyond a few months, this was in a young working woman of a highly neurotic temperament and probably many other elements entered into the condition. At the present time probably this operation would not be done.

In conclusion one might say that it is an operation to be undertaken only after careful study and where other measures have failed to afford relief, but in the selected cases it is well worth while.

#### EXCISION OF THE HEAD OF THE HUMERUS

DR T. TURNER THOMAS read a paper describing a new method of excising the head of the humerus, for which see page 492.

# TRANSACTIONS

## OF THE

### NEW YORK SURGICAL SOCIETY

*Stated Meeting, held April 11, 1917*

The President, DR CHARLES N DOWD, in the Chair

#### LARGE FECOLITH IN THE APPENDIX

DR WILLIAM A DOWNES presented a man, twenty-two years of age, who was admitted to St Luke's Hospital on March 11, 1917, with a history of pain in the abdomen, of two days' duration, cramp-like in character. Temperature  $100.4^{\circ}$ , pulse, 94, blood count showed leucocytes 24,000, with 90 per cent polynuclears.

At the outset the pain was referred to the penis and at frequent intervals during the two days he had considerable pain in the bladder. The morning after admission his temperature had gone down to  $99^{\circ}$ , pulse 84.

The diagnosis of acute appendicitis seemed most probable, but operation was deferred as the symptoms were subsiding. On account of the pain radiating to the bladder X-ray was taken, and it showed a definite shadow in the pelvis. This shadow was very large for an ureteral calculus, but a ureteral catheter was passed and a differential picture taken. It showed very distinctly that the catheter passed to one side of this shadow. This confirmed the diagnosis of fecolith.

On the third day after admission to the hospital, his temperature rose to  $101^{\circ}$ , and the abdomen became considerably distended. Dr Derby operated and found an enormously distended appendix containing a fecolith the size of a filbert.

DR CHAS DOWD, in discussing Dr Downes' case, referred to one in whom he had recently found clearly marked X-ray shadows from a large fecolith in a left-sided appendix. The symptoms had suggested a diverticulitis of the descending colon but X-ray pictures of the kidney tract were taken and the shadow of a large fecolith was found on the left side of the abdomen—once low and once high. This was verified at operation.

#### SARCOMA OF LEG, WITH INTRACRANIAL METASTASIS SPONTANEOUS DECOMPRESSION

DR DOWNES presented a girl, ten years of age, who was admitted to St Luke's on June 7, 1916. Her chief complaint at this time was pain in the occipital region, of six weeks' duration—constant, dull and non-radiating. Four years ago Dr Downes had amputated the left leg at New York Hospital, on account of a pathological tumor which proved to be round-celled sarcoma.

When admitted to St Luke's, Dr Cutler examined the eyes, and found

## CRANIOTOMY FOR CEREBELLAR CYST

vision 15/30m in right eye and 11/30m in left. Both eyes showed choked discs. He urged very strongly a decompression operation. It was agreed that there was in all probability an intracranial recurrence from the leg sarcoma. The family refused operation and she was discharged. Readmitted to the hospital on February 17, 1917. At this time she came in on account of a swelling 5 cm in diameter in the back of the head. This swelling was situated just at the left of the median line in the occipital region, was moderately tender, and seemed definitely attached on its under surface to the bone. Otherwise the physical signs were negative. Temperature at this time was 98.3°, pulse 98.

The X-ray picture at this time showed very distinctly a deficiency in the bone at this region. In the meantime, between her previous admission to the hospital in June, 1916, and February, 1917, at some time along about September, her headaches began to get less. Her eye symptoms at the time of this last examination were practically the same as before. They showed very little improvement over previous examination. She was sent to the Memorial Hospital, where she had one application of radium, and was given Coley's toxin. At the present time the local evidence of the tumor has disappeared, which is of little significance when it comes to giving a prognosis as to the future progress of the case.

The case was shown for the purpose of calling attention to the late recurrence—four years after amputation for sarcoma—and the relief of headache as a result of the spontaneous decompression.

## CRANIOTOMY FOR CEREBELLAR CYST

DR CHARLES A. ELSBERG presented a girl seventeen years old, who entered the Neurological Institute on the service of Dr. Peterson in January, 1917. Eight months before she began to be unsteady in walking and to have attacks of headache and vomiting. Two months later she developed diplopia and her vision began to fail. When she was admitted to the hospital she was bedridden, was extremely ataxic and unable to raise her head from the bed without having an attack of vomiting. Physical examination showed that there was marked choked disc with all the signs of an affection of the left lobe of the cerebellum.

Dr. Elsberg did a bilateral suboccipital craniotomy on January 13, 1917. The left cerebellar lobe bulged very markedly when the dura was incised, while there was no increase of tension on the right side. Aspiration of the left cerebellar lobe withdrew dark yellow fluid. An incision 3 cm long was made and about 5 c.c. of fluid evacuated. There was no evidence of a capsule. The wound in the cerebellum was left wide open and the soft parts closed in the usual manner. Convalescence from the operation was uninterrupted, the wound healed by primary union. The headache disappeared at once, the eye grounds returned to normal within two weeks. All of the ataxic symptoms grew rapidly less and when she was discharged on March 6 she was free from all symptoms.

The case was evidently one of a simple cyst of the cerebellum.

ABSCESS OF THE FRONTAL LOBE FOLLOWING ORBITAL  
CELLULITIS

DR ELSBERG presented a boy thirteen years of age, a private patient of Dr Peterson, who was admitted to the Neurological Institute in a much emaciated condition. Two months before, an abscess of the right orbit had been opened, he had recovered satisfactorily from this operation. Three weeks later he began to complain of right-sided headaches and then to lose strength and flesh rapidly. He had frequent attacks of vomiting, and a complete ophthalmoplegia of the right side. When admitted to the hospital his condition was very poor. He was pale and emaciated, there was considerable rigidity of the neck and decided Kernig, and he had the appearance of a patient suffering from tubercular meningitis. He had, however, a double choked disc with slight left facial weakness, and the possibility of a brain abscess was considered. Soon after his admission to the hospital he had a convulsive attack affecting the face and upper limbs, following this there was slight weakness of the left upper extremity. A few hours later he had another attack, after which the left upper extremity and the left side of the face were paralyzed. Within a few hours the patient became stuporous so that the right frontal lobe was explored without delay. A vertical incision was made in the right frontoparietal region. A button of bone removed with a trephine, the dura incised, and the brain aspirated. At a depth of 3 cm below the cortex thick green pus was obtained. Packings soaked in iodine were placed all around the wound and the exposed brain painted with tincture of iodine. The lobe was then incised and about 6 oz of pus under marked pressure were evacuated. The frontal lobe was drained with two tubes. Convalescence from the operation was very rapid.

The patient was discharged entirely well, free from all symptoms, two months after the operation. When discharged, the eye-grounds were normal and the ophthalmoplegia had entirely disappeared.

Dr Elsberg stated that there were some surgical principles in the treatment of brain abscess which were often neglected. A brain abscess should always be drained by two tubes and these tubes should never be removed at the dressings, but should be gradually shortened. If, before an abscess of the brain is opened, packings of gauze soaked in tincture of iodine are placed under the dura all around the wound there is practically no danger of meningeal infection. The drainage tubes should be held in place by sutures to the scalp, so that they can neither be pushed further into the brain nor become displaced in an outward direction. If these general surgical principles are followed, drainage of an abscess cavity in the brain can be carried out satisfactorily. It is wrong to remove a drainage tube from the brain and then attempt to reinsert it, because one can seldom get it into the same place again. In such attempts, the neighboring brain tissue will be sure to be injured.

## EXTRAMEDULLARY SPINAL CORD TUMOR

DR ELSBERG presented a man in whom he had removed a spinal cord tumor from the level of the twelfth dorsal segment in December, 1916. The

## NEUROFIBROMA IN THE CEREBELLO-PONTINE ANGLE

patient presented all the symptoms of a growth at this level, but operation was much delayed on account of a history of syphilis and a positive Wassermann reaction. The tumor removed was a typical glioma and the patient recovered very satisfactorily from the operation.

There is no reason why a patient cannot have syphilis and at the same time a spinal cord tumor, and this has been the case in several patients operated by the speaker.

Whenever, in a patient with a positive Wassermann the symptoms of spinal compression are not quickly improved by antisyphilitic treatment, operation should be performed without delay. The patients with spinal cord gummata usually improve very rapidly after the first salvarsan treatment, as occurred in a patient recently seen by the speaker. If the symptoms do not rapidly improve, it means that either the gumma is so large that its actual removal is indicated or that the growth has nothing to do with the systemic syphilis. It is wrong to permit a patient to become paraplegic while antisyphilitic treatment is being tried. If treatment does not show immediate improvement, and if the spinal symptoms grow worse, the surgeon should not hesitate but should proceed to operative treatment without delay.

## NEUROFIBROMA IN THE CEREBELLO-PONTINE ANGLE

DR. ELSBERG presented a man fifty years of age from whom he had removed a tumor from the cerebello-pontine angle fourteen months before. When the patient was admitted to the Neurological Institute he gave a typical history and the characteristic signs and symptoms of a tumor in the right cerebello-pontine angle. He was operated in February, 1916, a bilateral suboccipital craniotomy being performed, and the tumor enucleated inside of the capsule. The patient had recovered nicely from the operation and his symptoms had gradually improved up to the present time.

The patient was presented in order to call the attention of surgeons to a method of removal of these tumors which has been very satisfactory, and which has markedly lessened the mortality from these operations. Small tumors (up to the size of a cherry) in the cerebello-pontine angle can be safely removed with their capsule. Large tumors are usually closely adherent to the sides of the pons and medulla, and their removal *with* the capsule is very apt to cause a secondary softening of these structures. A slight hemorrhage in this region is only too apt to result fatally. Neurofibromas in the cerebello-pontine angle grow very slowly and are clinically benign. They do harm only by pressure. It does no harm to leave the capsule behind. Therefore if, when such a tumor is exposed, it is found to be of large size, no attempt should be made to remove it with its capsule, but an incision should be made into the capsule, and with a sharp curette all the tumor should be scraped away. Although the capsule is usually fairly tough, care must be taken that the capsule

is not perforated All the manipulations should be done with gentleness, and special care should be taken when curetting out the mesially placed portions of the growth

By this method, all of the tumor is removed within its capsule and the capsule is allowed to remain behind The intracapsular enucleation of tumors in the cerebello-pontine angle is a very satisfactory method of procedure, and the large majority of the patients recover from the operation

#### EXTRAMEDULLARY SPINAL CORD TUMOR

DR ELSBERG presented a patient forty-eight years of age who was admitted to the Neurological Institute with all the signs of extramedullary compression of the cord at the sixth dorsal level Two years before, the patient began to have attacks of pain over the left hip Soon after, she began to have difficulty in walking, both limbs becoming stiff, weak and numb For three and one-half months she had lost complete power in the lower limbs with incontinence of urine and feces

Physical examination showed sensory and motor signs up to the sixth dorsal segment Operative interference was considered urgent At the operation an extramedullary tumor the size of an almond was removed from the posterior surface of the cord The growth was a typical endothelioma and very hard in consistency Convalescence from the operation was uneventful, in spite of the three and a half months paraplegia, return of power began very early Ten days after the operation she was able to move the right leg somewhat and soon afterwards began to regain control in the left leg Four weeks later she had regained complete control of the bladder and rectum When she was seen last, five months after the operation, all sensory and motor disturbances had disappeared and she was entirely well

Dr Elsberg stated that the small hard growths are much more apt to cause an early and irremediable injury to the cord than the larger and softer ones In the speaker's experience the larger the tumor that was removed, the less the injury to the cord He had seen a number of patients with small, easily removable growths in whom the paraplegia had persisted in spite of removal of the growth

#### SPINA BIFIDA

DR ELSBERG presented a patient upon whom he had operated over a year ago for a ruptured spina bifida in the mid-dorsal region The child was operated when it was three days old It recovered entirely from the operation, and was presented well and strong In connection with this case, Dr Elsberg mentioned the fact that he had seen and operated upon quite a number of infants with ruptured spina bifida, but in only one of them had a meningeal infection occurred Several of the patients were operated one to two weeks after the rupture of the sac It seems that meningeal infection is less apt to occur in infants, and Dr Elsberg asked whether this had been the experience of other members of the Surgical Society

DR WILLIAM G DOWNES said that he had operated on a very large spina bifida in the lumbosacral region forty-eight hours after rupture, which made a perfect immediate recovery. Yet he had seen two or three others brought into the hospital rather late that had died from the meningeal symptoms, in which there were other conditions which made it unwise to perform any operation.

DR CHAS N DOWD, in speaking of spina bifida, referred to one of these children whose sac had been ruptured for two days and in whom excellent closure was obtained by the turning in of fascial flaps.

He also asked whether any of the members of the Society had seen cases of spina bifida who developed into normal children. Some of the pediatricists claim that such development cannot be expected.

DR DOWNES quoted a case of about four years' standing where he removed a large meningocele in the upper dorsal region that had apparently remained well. However, he had done several others that he thought were just as favorable and they had developed hydrocephalus in a short time. He knew certain pediatricists who doubt the advisability of operating on any case of spina bifida on account of the tendency to develop hydrocephalus.

DR ARTHUR L FISK had seen within the last week a child four months old, who has a meningocele high up in the cervical region. In fact there are two, one, a small sac about the size of a large olive, which is shrivelled and covered by a thin parchment-like skin over its apex, the second is a sac as large as a Tangerine orange, the skin covering this is thin in spots, showing fluid beneath, but elsewhere it is thick, very like scar tissue. When the child cries no impulse can be felt in either sac. The anterior fontanel is closed. He had advised against operation at the present time because nature seemed to be gradually obliterating the communication between the spinal canal and the sacs, in a safer and simpler manner than by surgical interference. The child did not show any evidences of paralysis and it was apparently bright mentally.

DR ALFRED S TAYLOR said that it had always seemed to him that the statement that is made in the books that hydrocephalus follows the operation should not be put in just that way. It is true that very frequently operation upon spina bifida precedes hydrocephalus, but it is his belief that the hydrocephalus is a thing that would be developing anyway and that the hydrocephalus and spina bifida are both of them the result of some fundamental disturbance in the formation of the child and that the closure of the sac has practically nothing to do with the development of hydrocephalus except that it precedes it in time.

He had operated on one or two spina bifidas where hydrocephalus was already present, perfectly definitely developed. The operation was not done for any other reason than simply to make the child easier to take care of mechanically. In those cases the spina bifida was a protrusion, a couple of inches backward from the spine, and it was necessary to cover it with a big ring, so that it would not be ruptured. The feet and legs were powerless and more or less deformed and spastic, and it was explained carefully to the



parents that the operation was done for purely mechanical effect rather than for any other purpose—as it would render easier the care of the child during its life

DR ELSBERG remarked that he had tried—based on the newer ideas of cerebrospinal fluid circulation—to explain the occurrence of hydrocephalus. He did not think that ventricular distention after operations for spina bifida is due to the operation, but it is apt to be made worse by the operation. He has tried to explain the occurrence of hydrocephalus in infants with spina bifida in the following way:

It is now known that the circulation of spinal fluid follows a certain definite course. The fluid flows down on the posterior side of the cord and passes up on the anterior surface of the cord. There is a valve-like arrangement of the arachnoid on the anterior surface near the foramen magnum which favors the passage of fluid upward, so that in general there is a current of cerebrospinal fluid downward on the posterior and upward on the anterior surface of the cord. Now, if there exists a spina bifida, there is an obstruction to the passage of the cerebrospinal fluid past that point, which is probably very often made worse if the patient is operated. There is then an obstruction to the flow of the fluid (which is sooner or later followed by hydrocephalus) and this obstruction is likely to be increased by the operation.

He always determines whether the absorption from the subarachnoid space is normal by means of the phenolphthalein test. If subarachnoid absorption is normal, then he considers the hydrocephalus to be a real obstructive hydrocephalus. Instead of being in the iter or the foramina of Magendie and Luschka, the obstruction is lower down in the spinal canal. In such patients he does a puncture of the corpus callosum. After this procedure he had had a considerable number of patients with spina bifida who were well after five, six, seven or eight years. For all of these reasons, he considered the hydrocephalus that follows spina bifida a true obstructive hydrocephalus.

#### GIANT DUODENUM

DR WILLIAM A. DOWNES read a paper with the above title, for which see page 436

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## THE TREATMENT OF STAPHYLOCOCCUS SEPTICÆMIA BY TRANSFUSION OF IMMUNE BLOOD

BY RANSOM S. HOOKER, M.D.

OF NEW YORK

ASSOCIATE SURGEON, BELLEVUE HOSPITAL, N. Y.

THE performance of blood transfusion has been greatly extended during the past four years. Reports in the literature covering this period show that it has been resorted to as a therapeutic measure for many and varied pathological conditions. Since 1912 I have been associated with Dr. H. S. Satterlee, at first in experimental and technical studies of blood transfusion, and later in the clinical employment of the operation.

Early in this work it became apparent that the use of specially immunized donors, in conditions of bacterial infections and other definitely toxic disturbances, would be a most desirable procedure from a theoretical standpoint. Our first opportunity to test the practical application of this idea was in April, 1913, and we reported the case in January of the following year<sup>1</sup>. Since that time there have been a few cases reported of transfusion of immune blood for typhoid fever, tuberculosis and streptococcus septicæmia, but I have not been able to find any reports of the transfusion of immune blood for staphylococcus infection. As we have had in our series five cases of transfusion for this condition, in four of which we have immunized the donors, I believe the group is of sufficient interest to report, although the number is not large enough to justify important conclusions.

Briefly summarized the cases were as follows:

(a) There were two hospital cases, both chronic staphylococcus infections accompanying a long-standing condition of multiple suppurative osteomyelitis and resulting in general sepsis, progressive anæmia and failing resistance.

(b) The other three cases were all seen in private practice and were general bacteræmias developing rapidly from localized acute suppurative processes.

In all five of these cases the patients were so ill at the time transfusion was proposed that the outlook was considered well-nigh hope-

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<sup>1</sup> Arch. Int. Med., 1914, xiii, 71.

less and transfusion was resorted to as the only available chance of avoiding a fatal issue. The two chronic cases made a complete recovery. One of the acute cases, an osteomyelitis of the tibia and radius, made an immediate and uneventful recovery, the other two acute cases, both affections of the face with bony involvement, improved in a most striking manner but died suddenly, while seemingly convalescent, from cerebral embolism on the eighth and eighteenth days, respectively, following their last transfusion. One of the series was transfused from a non-immunized donor. The other four were transfused with blood from donors who had been subjected to varying degrees of immunization with vaccines derived from the patient's infecting organism.

The cases in detail are as follows

CASE I—Boy, E. M., eleven years nine months old, admitted to Bellevue Hospital December 2, 1912

*Family History*—Negative

*Previous History*—Negative

*Present Illness*—Five days ago, after playing out of doors, he came home with headache, vomited and had high fever with delirium. Two days later he developed a pain in the right leg and thigh and was taken to hospital with diagnosis of typhoid fever.

*Physical Examination on Admission*—Patient in somnolent, semidelirious condition, with eyes closed and every appearance of an acute toxæmia. Routine physical examination revealed nothing except a slight general enlargement of the lymph-nodes, a few fine petechial spots over the abdomen and back and a very swollen and tender left leg from the hip-joint to below the knee, the circumference being nearly twice that of the opposite side. No fracture or deformity of the femur was made out.

*Course*—The day following admission the lower third of the left femur was opened and pus was found, which yielded staphylococcus aureus on culture. Three weeks later, December 23, the lower and the middle thirds of the bone were opened. On December 28, a similar condition developed at the inner end of the left clavicle and was opened, and on January 5 the inner end of the right clavicle was opened. On this date pus from both clavicles showed staphylococcus aureus. On January 13 blood culture showed staphylococcus aureus and the picture became one of general sepsis with pyæmic foci. In February vaccines were made from the femoral pus and administered to the patient without improvement, in fact the patient became worse and developed additional foci in the left elbow and in the distal phalanx of a finger.

On March 31 the outlook seemed so hopeless that it was decided to try the effect of transfusion from an immunized donor. The blood of an uncle of the boy was found compatible and he was vaccinated with progressively increasing doses of a fresh

vaccine made from the infecting organism (pus from femur) Vaccination of the prospective donor was continued throughout April.

On April 18, X-ray plates showed fracture of the left femur and osteomyelitis of the entire shaft On April 28 the patient seemed to be failing rapidly There were albumin and waxy casts in the urine and the hæmoglobin was 30 per cent On April 29 a transfusion of 100 c c was performed from the immunized donor and the bone sinuses were packed with gauze saturated with the donor's blood There followed a rapid improvement in the boy's condition and ten days after the transfusion the hæmoglobin had risen to 80 per cent Shortly afterwards the patient had gained so much in weight and in strength that he was able to wheel himself about in a chair. After a somewhat tedious convalescence, due to the multiple bone sinuses, he was discharged cured on November 28

CASE II—Boy, B K, nine years old, Tuxedo Hospital, Tuxedo, N Y. Seen in consultation January 13, 1915

*History*—The patient had been ill in the hospital for about one year with staphylococcus septicæmia During that time he had osteomyelitis of both femurs and right ulna, and had several operations upon these bones Cultures had been taken from all points of infection and staphylococcus aureus had been found in all, but no blood culture had been made For the past three weeks he had been running an evening temperature of 101°–104° F and had an apparently increasing general sepsis There was extensive involvement of the shaft and head of the right femur extending into the hip-joint The condition was so desperate that transfusion seemed advisable to prepare the patient to stand the shock of a proposed amputation of the right leg at the hip The leucocytes were 20,000, polynuclears 99 per cent, hæmoglobin 30 per cent, temperature 105° F, pulse 178 and of poor quality Hæmolysis and agglutination tests of the blood of the patient's sister were found satisfactory A transfusion was done at once, the sister serving as donor Five hundred cubic centimetres of blood were given After transfusion there was so much immediate improvement that it was decided not to amputate, but to hope for some permanently beneficial effect from the transfusion and to immunize the sister for a later transfusion The patient's condition remained most serious for about ten days, when a gradual improvement began and the sister declined to serve again as donor The improvement continued steadily, nevertheless, until he was discharged from the hospital the following August, with all sinuses closed He remained well until January, 1916, when he contracted measles and died of a complicating pneumonia

CASE III—Boy, F P, four years old Family and previous history negative Perfectly well up to April 6, 1915, when it was noticed in the morning that he had some blisters on the palm

of the right hand and some soreness about two of the finger nails Temperature  $102^{\circ}$  F

April 7 When seen in the afternoon by a general surgeon there appeared to be a beginning paronychia of the little and ring fingers of the right hand, and there were one or two blebs on the palm The temperature had risen to  $103.8^{\circ}$  F and the boy looked sick A wet dressing was applied That night he became wildly delirious and when seen the next morning he seemed sicker, and a superficial infection of the left little toe was found The urine continued with a heavy trace of albumin and casts Blood count showed 23,000 leucocytes and 82 per cent polynuclears A culture was made of the serum from the blebs and also a blood culture Temperature, A M,  $103.8^{\circ}$ , P M,  $99^{\circ}$

April 8 Very delirious most of the time Morning temperature  $103.8^{\circ}$ , evening temperature  $101.2^{\circ}$  There was a tender spot over the head of the left tibia which was incised under cocaine Some serum was found in the overlying tissues, the bone and periosteum both appeared normal The second toe of the right foot began to show a superficial infection and was incised but contained no serum

April 9 Condition the same Temperature  $102.4^{\circ}$  in the morning,  $103.4^{\circ}$  at night Blood culture of April 7 showed staphylococcus aureus and there was a growth of the same organism from the culture of the bleb serum

April 10 Some thickening was noticed of the left lower radius The urine contained blood and 12 per cent of albumin by volume There was a slight systolic murmur over the base of the heart Patient continued delirious and had a morning temperature of  $103.8^{\circ}$ , with remission to  $100^{\circ}$  in the afternoon The father of the boy was given two 50-million doses of a vaccine made from the blood culture

April 11 The father was given a third dose of 100 million of the vaccine and the patient was prepared for operation, the intention being to give the transfusion simultaneously or immediately following Under ether anæsthesia the left radius and right tibia were opened and pus was found in both The patient went into collapse on the operating table and the transfusion was done at once Three hundred cubic centimetres of blood was transfused and there followed a marked immediate improvement in the condition of the patient During the day another toe infection was noticed and that night it was discovered that there was swelling and tenderness of the right side of the scalp

*Subsequent Course*—There was a definite and progressive improvement of all symptoms during the forty-eight hours following the transfusion, so that it was thought unnecessary to repeat it, although the vaccination of the father had been continued On the eleventh day of illness, and five days after transfusion, the patient was thought to be out of danger, on the sixteenth day the temperature reached normal and he was allowed

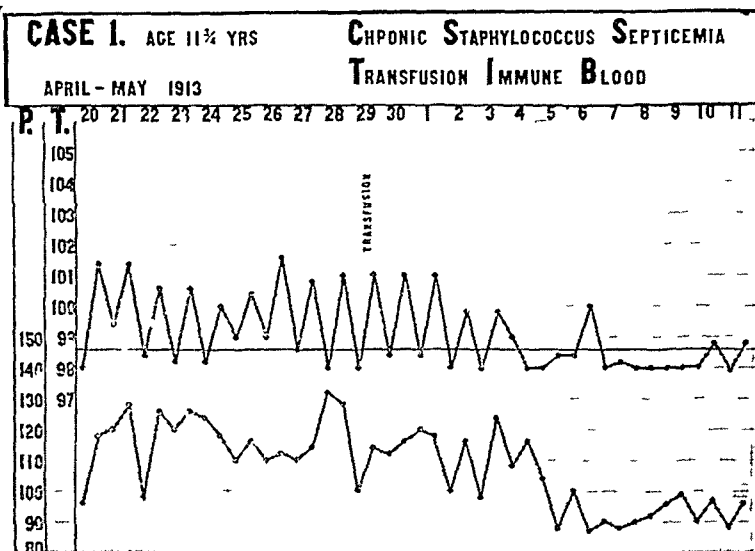


FIG 1

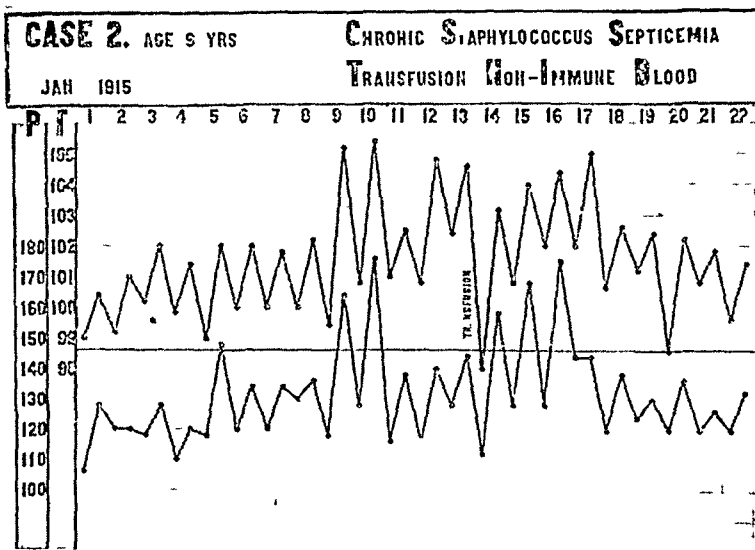


FIG 2

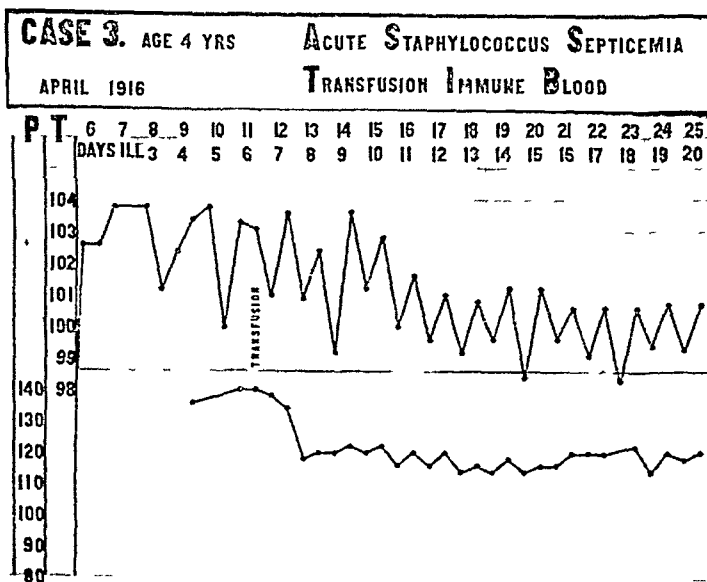


FIG 3

**CASE 4** AGE 2½ YRS      **ACUTE STAPHYLOCCUS SEPTICEMIA**  
**APRIL 1916**      **TRANSFUSION IMMUNE BLOOD**

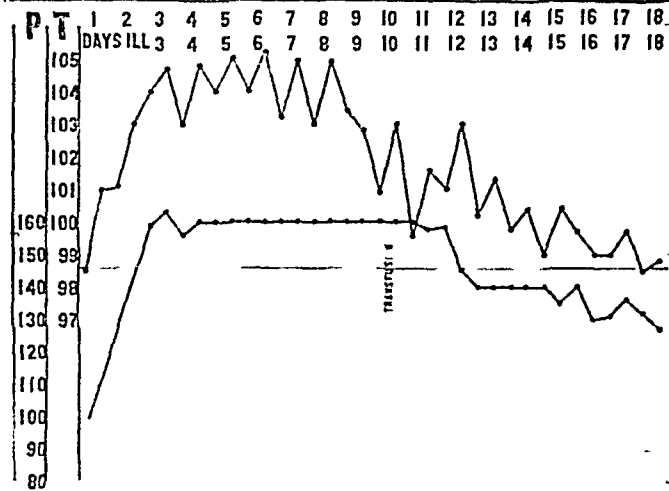


FIG 4

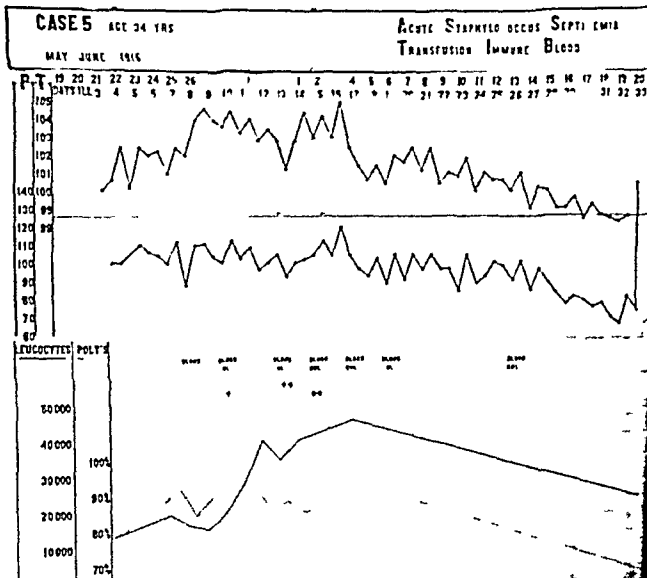


FIG 5

## TREATMENT OF SEPTICÆMIA BY TRANSFUSION

to sit up in bed. The bone sinuses were all closed by the middle of June. On July 6 a sequestrum was removed from the left radius. Several times subsequently the sinuses opened and discharged slightly. At the time of writing (March, 1917) they had been closed for eight months and the X-ray plates show an apparently healthy bone structure.

CASE IV—Girl, E. M., two years ten months old. Family and previous history negative. On April 1, 1916, a coryza developed. During the next three days the face began to swell and the child seemed to become rapidly septic with gradually ascending temperature.

April 4. Leucocytes 20,600, polynuclears 84 per cent. Urine showed albumin and casts.

April 5. Leucocytes 18,500, polynuclears 80 per cent. Blood culture was made. The face was much swollen and the temperature had reached 105°. A rhinologist saw the child in consultation and punctured the left antrum, evacuating some pus which on culture showed staphylococcus aureus.

April 6. Blood culture of previous day showed staphylococcus aureus, and a vaccine was made from which the patient's father received an initial dose of 50 million. The patient had signs of a beginning pneumonia of the left lower lobe which subsequently developed into signs of consolidation.

April 7. A subperiosteal abscess was discovered above the left upper incisor teeth and this was opened. Culture from this abscess yielded staphylococcus aureus. There was also a cellulitis of the surrounding tissues on the left side of the face. Signs of an effusion appeared in the pericardium and also in both pleural cavities. The father received a dose of 100 million vaccines in the morning and another of 200 million twelve hours later. Transfusion was considered at this time, but the heart's action was so poor that it was deemed wiser to postpone it.

April 8. Patient's condition the same. The father was given a fourth dose of 250 million vaccines.

April 9. Signs of beginning resolution left lower lobe. Apparent increase in chest and pericardial fluid. The father was given a fifth dose of 400 million vaccines.

April 10. The patient became much weaker and transfusion was done, 125 c c of the father's blood being given.

April 11. Condition much improved.

*Subsequent History*—From April 12 to 18 the child improved steadily with a gradual subsidence of the temperature and pulse rate. During this time the signs over the lungs and heart indicated a diminution of the pleuritic and pericardial effusion, although the rate of respiration continued high. On April 18 the temperature reached normal in the morning and all day the child seemed in better general condition than at any previous time of her illness. At 11 o'clock at night she suddenly died, apparently from cerebral embolism. No autopsy was allowed, but imme-



diately after death the pleural and pericardial cavities were aspirated and pus was obtained from all. Differential cell count of the pericardial fluid showed 95 per cent of polynuclear leucocytes with many intracellular staphylococci. The fluid from the pleural cavities showed 100 per cent polynuclears, also with many intracellular staphylococci.

CASE V—Man, L. G., aged thirty-four. On May 19, 1915, the patient had been in perfect health, but noticed a small boil on the inside and front of the left nostril. He consulted a rhinologist, who opened it at his office. The next day the pain and extent of the inflammation had increased and there was considerable induration. On May 21 the whole nose and upper face was swollen with an increased area of redness and brawny induration. The opening in the nostril was enlarged. It was thought that he was developing erysipelas and he was sent to St. Luke's Hospital.

May 22. On admission to the hospital his leucocytes were 15,000, polynuclears 82 per cent, the urine was normal. For the next three days his condition remained about the same with an afternoon temperature of a little over 102° F. The leucocytes increased to 20,500 and the polynuclears to 94 per cent and the urine began to show albumin and casts.

May 26. A culture from the discharging sinus in the nose showed staphylococcus aureus and a blood culture taken on the same day gave a growth of staphylococcus aureus in small numbers on plates, but the broth cultures were negative. The temperature rose in the afternoon to 104° F and for nine days following remained nearly at that elevation. The patient appeared generally septic and the prognosis became very grave. There was alternating delirium and stupor and a constantly increasing leucocyte count, as shown on the chart (Fig. 5). Blood cultures showed an increasing bacteriæmia. Two brothers were found to have blood compatible for transfusion and both were immunized with vaccines derived from the organism found in the patient's blood. Locally the infection had spread to the orbit of the left side and this required surgical treatment. Pus from the eye gave a growth of staphylococcus aureus.

May 31. The thirteenth day of illness, the patient was in a very alarming condition with active delirium and occasional periods of stupor from which it was difficult to arouse him. He was given his first transfusion that day—300 c c of blood from one of his brothers who had received four doses of vaccines. About 150 c c of the patient's blood was taken off as a preliminary.

June 1. The day following the first transfusion, there was very little change.

On June 2 a blood culture was taken and this subsequently showed very marked diminution in the bacteria content as compared with that which had been taken the day before transfusion.

## TREATMENT OF SEPTICÆMIA BY TRANSFUSION

A second transfusion was given that afternoon of 250 c.c. from the same brother. The next day, June 3, the patient showed improvement, especially in his mental condition, but the temperature went to 105° in the afternoon.

On June 4 the temperature dropped to below 102°, the pulse from 120 to 96, and there was a very marked amelioration of all symptoms. The leucocytes on this day reached 47,000, the highest count which had been obtained, and blood culture showed a growth in only one flask, and on none of the plates after six days.

On June 6 another blood culture was made and this developed only a single colony on one plate and nothing in the broth flasks.

Blood cultures taken on June 12 and 13 proved absolutely negative.

June 14. The temperature reached 99°, and the pulse 80. The patient was allowed to sit up in bed and he was thought to be making a rapid convalescence. Everything continued to improve without interruption for the next five days and the patient was allowed to sit in a chair and to move to a lounge from his bed.

On June 20, at 8 10 A M, he was feeling perfectly well with a pulse of 72. Twenty minutes later he complained of pain in his head, his pulse was 144, his respiration became rapid and shallow. Blood-pressure was 210 mm Hg. Fifteen minutes later he lapsed into unconsciousness and died. No autopsy was allowed.

*Summary and Discussion*—After reviewing these case histories from a critical standpoint there are certain indications for management and factors of judgment which assume a collective importance in the retrospect which was not perhaps sufficiently evident at the time of occurrence. It seems worth while, therefore, to summarize the experience which has been gained from this broader view.

In Cases I, II and III it would have been valuable to have followed the bacteria content of the blood after the first transfusion and to have repeated transfusion within a few days if there were not a prompt diminution or cessation of the bacteræmia, and this, I believe, should be a general rule in all cases.

Case II illustrates a point which it is important not to forget when considering the indications for transfusion in such conditions, and that is that there is almost always a pronounced secondary anæmia and that normal resistance to infection is very much impaired by this alone. Transfusion of normal blood is therefore of assistance in combating the infection by simply correcting the anæmia and thus helping to restore normal resistance.

In Case III transfusion should have been done earlier with non-immune blood if necessary, and a second transfusion with immune blood could have followed. In all three cases there was, notwithstand-

ing these seeming errors of judgment, a favorable outcome definitely attributable to the transfusion

In Case IV the toxæmia, and presumably the bacteræmia, was favorably influenced by the transfusion, but it is to be regretted that the transfusion was not given earlier and repeated according to indications. How far phagocytosis was influenced by transfusion in this case would have been an interesting study and might have had special prognostic significance in view of the extensive exudation into the pleural and pericardial sacs. What would have been the outcome in this case if death had not come suddenly from embolism is hard to conjecture.

In Case V the progress of the system infection and reaction against it is fairly well shown on the chart by the leucocyte curves and the blood culture findings. The striking improvement in the whole clinical picture left little room to doubt that the transfusions were the deciding influence in changing a hopeless prognosis into a confident expectation of recovery.

Embolism from septic thrombi is probably an unavoidable danger in the course of, and during, recovery from any bacterial infection of the blood, but is particularly apt to occur with primary infections of the face and of the orbital, nasal and oral cavities.

#### CONCLUSIONS

*Chronic Infections*—The general conclusion to be drawn from a study of the experiences which have been here related is decidedly in favor of the efficacy of immunized blood transfusion in chronic staphylococcus septicæmias, and especially in those which complicate bone conditions. This conclusion would seem applicable to any delayed recovery from severe staphylococcus infection where the resistance is lessening and is likely to be non-responsive to active immunization by vaccines.

Another interesting and as yet unreported case, which falls into this category, is one which has been recently brought to my attention by Dr. K. M. Vogel, having occurred last December in his service at St. Luke's Hospital. This patient developed a staphylococcus bacteræmia on the thirty-seventh day of typhoid fever and was in a very serious condition for fifteen days following. She was transfused three times with staphylococcus immune blood, on the fifty-second, the sixty-fifth and the eightieth days of her illness. There was an apparently favorable response to each transfusion and the patient made an uninterrupted recovery.

In this class of cases there is usually ample time to prepare a suitable donor by administration of vaccines, but if the anæmia is pronounced no time should be lost in performing a preliminary transfusion of normal blood.

*Acute Infections* —Early blood cultures and an immediate start to immunize a donor are of the utmost importance in these cases. If urgent, it is best not to wait for full immunization but to give the first transfusion even after one dose of vaccines. The effects of transfusion by study of blood counts, blood cultures and general symptoms should be observed and the operation repeated as indications arise, being mainly guided by the bacteræmia. If the patient has a fairly good blood volume with a high bacterial blood content, there should be no hesitation in removing a considerable amount of blood by venesection just before transfusion.

*Special Results From This Study* —During the study of these cases it has repeatedly occurred to us that it would be a great advantage if there were some practical way in which the patient's blood might be tested for its inhibiting action on the growth of the infecting organism and for its opsonic power, and that the blood of various donors might also advantageously be so tested and compared, especially when there is little time for immunization of the donors by vaccines. This would not only show a possible preference in natural immunity towards staphylococcus possessed by different donors, but it would afford a criterion of the desirability of removing some of the patient's blood before transfusion in the event of its showing a low index of immunity, thus permitting the transfusion of a greater volume of blood from the donor.

A careful opsonic determination of the patient's blood and of that of different donors by the method of Neufeld, or the employment of a complement-fixation method to determine antibodies might accomplish such a purpose. But neither of these alternatives is easily applicable and both are too slow to satisfy the urgent need of quick findings.

What promises to be a much more practical way of getting the desired information in a short space of time has been suggested to us by Dr. Hans Zinsser, and that is, a method of specific protection on mice. The laboratory details of such a method we hope to work out in the near future under Dr. Zinsser's direction.

# PERSISTENCE OF BACTERIA WITHIN SEQUESTRA

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AND

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THE treatment of the old suppurating fracture, resulting from a shell or rifle-ball wound, offers one of the most difficult problems in the base hospital. Perhaps no other form of injury withholds from active service such a large number of men for such a long period of time. For this reason it seems advisable to publish the incomplete data so far at hand resulting from investigation of the bacterial flora of these wounds. These data include observations on the persistence of various bacteria within the wounds and especially within the bone itself, the recrudescence of infection following operations on a septic field, commonly called a "flare," the possible reaction of anaerobic bacilli to this recrudescence of infection.

It is difficult to get an accurate idea of the bacteria persisting in the suppurating fracture. Many bacteria, especially the anaerobes, are found in a low state of vegetative activity, so that cultures frequently show only the growth of the more active aerobic or facultative flora. A long period of incubation, usually a week or ten days, is necessary for the development of some of the spore-bearing anaerobes.

For this study sequestra from a continuous series of secondary operations on suppurating compound fractures were examined. The cases were chiefly fractures of the long bones which had reached the stage of bone sinuses, or, in two instances, were completely closed but showed sequestra on X-ray examination. They varied in age from forty-five days to three hundred days. In the majority of cases the specimen examined was removed at operation about one hundred and thirty days after the original injury. They varied in size from a few millimetres to several centimetres in diameter. The cultural technic was as follows:

*Method of Examination*—In order to determine if there were any difference between the flora of the wound itself and the flora within the sequestrum the following technic was employed. To determine the flora of the wound the sequestrum was placed into sterile saline solution and well shaken. The resulting *emulsion* was inoculated into deep agar, upon agar plates, into anaerobic broth, into meat culture medium and into milk. To determine the flora within the sequestrum the sequestrum was removed from the saline emulsion, dried, and sterilized by being dipped into alcohol and flamed, this procedure being considered adequate to destroy most of the

## BACTERIA WITHIN SEQUESTRA

organisms present outside the bone The sequestrum was then inoculated into deep agar or meat Afterwards it was removed from the culture tube, decalcified, sectioned and studied histologically

*Distribution of Bacteria*—Both the emulsion containing the flora of the wound and the interior of the sequestrum showed a large and varied flora Streptococci, staphylococci, diphtheroid bacilli, the *B. pyocyaneus*, Colon bacilli, the *B. proteus*, the *B. aerogenes capsulatus*, the *B. malignans oedematis*, the Hibler bacillus No IX types were among those most frequently found both in the emulsion and in the sequestrum

In about 90 per cent of the specimens of bone examined histologically, bacteria were seen lying well within the substance of the sequestrum, usually in nests within the canals or cell spaces

It was observed that certain organisms were obtained more frequently from the interior of the sequestrum than from the emulsion containing the wound flora Table I shows a comparison of the flora derived from the two sources It was found to be impossible in the time available to identify the species of all the bacteria recovered from each case They were therefore classified in the following groups Aerobes staphylococci, streptococci, small Gram-negative bacilli, small Gram-positive bacilli, anaerobes gas-forming organisms and spore-bearers The table shows the percentage incidence of each group of organism recovered from the wound and from within the sequestra of 48 consecutive cases

TABLE I

PERCENTAGE INCIDENCE OF VARIOUS GROUPS OF BACTERIA IN WOUND AND IN SEQUESTRUM FROM 48 CONSECUTIVE CASES

Group of organisms	Aerobes				Anaerobes	
	Staphylococcus	Streptococcus	Small Gram-negative bacilli	Small Gram-positive bacilli	Gas-forming bacilli	Spores
Wound	52	66	60	42	14	7
Sequestrum	62	80	74	53	55	42

It may be noted that each group of organisms was recovered more frequently from the sequestrum than from the wound, suggesting a richer flora within the former One point, however, is especially evident, and that is the greater incidence of the anaerobic group within the sequestrum Gas-forming anaerobes developed nearly four times more often from the bone than from the wound, while spores were present six times more often In no case were gas or spore-producing anaerobes recovered from the wound when not recovered from the sequestrum removed from it *The bone itself appears to be the most common site for the persistence of the anaerobic flora*

It is interesting to divide the 48 cases according to the age of the wound When those from which the sequestra were removed within 120 days of the injury (numbering 22) are compared with those which varied in age from 120 to 300 days (numbering 26), as in Table II, one variable feature may

be remarked The flora recovered both from the wound and from the bone showed a much higher incidence of anaerobes in the older cases than in the newer The aerobic flora from both wound and bone showed no great variation in the two groups of cases, except that the incidence of staphylococci was higher and that of streptococci lower in the old cases than in the new The occurrence of flares, which is discussed later, is added to the table

TABLE II  
PERCENTAGE INCIDENCE OF VARIOUS GROUPS OF BACTERIA IN WOUNDS AND SEQUESTRA  
IN EARLY AND LATE CASES

Group of organisms	Wound						Sequestrum						Flares
	Aërobes				Anaërobes		Aërobes				Anaërobes		
	Staphylococcus	Streptococcus	Small Gram-negative bacilli	Small Gram-positive bacilli	Gas forming bacilli	Spores	Staphylococcus	Streptococcus	Small Gram negative bacilli	Small Gram-positive bacilli	Gas forming bacilli	Spores	
22 cases, less than 120 days	45	77	64	36	9	0	45	86	77	50	45	27	32
26 cases, more than 120 days	58	62	58	50	15	15	73	77	69	54	65	42	58

#### CAUSES OF PERSISTENCE WITHIN SEQUESTRA

*Structure of Bone*—The persistence of bacteria for such a long period within the bone is probably due to the mechanical protection afforded by the dense structure of the bone itself for organisms present within its spaces and canaliculi There they are well protected from the body fluids and phagocytic cells Leucocytes were very rarely seen within the bone in any of the sequestra sectioned

Furthermore, the bacteria are protected from any antiseptic which may be introduced into the wound A few attempts to sterilize bone sequestra *in vitro* by strong antiseptics were sufficient to demonstrate the improbability of accomplishing this result within the wound Small splinters of only a few millimetres in diameter may be soaked in alcohol 75 per cent, hydrogen peroxide, Dakin's solution, bichloride of mercury 1-10,000, 5 per cent carbolic acid or tincture of iodine, for half an hour or more and a good growth of organisms obtained after breaking and resowing the splinter into a suitable medium

*Alkaline Salts of Bone*—There is another factor which may favor the persistence of bacteria within bone It is recognized that to secure a long-continued growth of bacteria in artificial media the life of certain acid-producing organisms may be greatly extended by the addition of chalk to the medium to prevent the accumulation of some of the acid products and the consequent autogenous sterilization of the organism The conditions about the organism within the bone may be compared to the environment of those grown *in vitro* in the chalk tubes It seems probable that the insoluble bone

salts may combine with the acids produced during the growth of the bacteria and thus remove by-products which usually tend to limit their growth. At the same time this reaction will result in a loss of substance on the part of the sequestrum

*Erosive Action of Bacteria on Sequestra*—*In vitro* experiments on the action of various organisms on sterilized and thoroughly dried pieces of beef bone were conducted to determine how the loss in weight varied with different organisms. Small pieces of compact bone, weighing approximately half a gramme, were incubated in a meat culture of the gas bacillus, the *B. malignans oedematis*, the Hibler bacillus No. IX, the *B. proteus*, *Staphylococcus aureus*, or *Streptococcus pyogenes* for a period of ten days. After this period the bones were removed, washed thoroughly, dried, as before, in a dry sterilizer, and weighed. The results of several experiments were fairly consistent. The Hibler bacillus usually produced the greatest loss in weight (approximately 8 per cent of the previous dry weight). The gas bacillus and the *B. malignans oedematis* caused a loss of about 6 per cent in the same period of time, while the bones incubated with the streptococcus and the *B. proteus* usually lost less than  $3\frac{1}{2}$  per cent. *Staphylococcus* proved the least active of all, never producing more than 2 per cent loss—no more than that of the uninoculated control. Part of this loss in weight may have been due to the digestion of the small part of protein material present even in compact bone, but since the same pieces of bone were used for two and sometimes three successive experiments, and the loss in weight continued to occur at about the same ratio, the loss due to the digestion of the soft constituents must have been only a small fraction of the total.

*Erosive Action of Certain Organic Acids on Sequestra*—Since some organisms produce considerable quantities of organic acids in the process of growth, the loss in the weight of the bone due to the solvent action of some of these acids was compared with the loss due to the action of the bacteria. Specimens of bone were placed in 1 per cent solutions of acetic, propionic or butyric acids and incubated for ten days, the same time as the bacterial cultures. The specimens from the acetic tubes showed an average loss during this period of about 14 per cent; those from the propionic tubes an average of about 11 per cent, those from the butyric tubes an average of 7.1 per cent—slightly more than the average loss from the action of the *B. aerogenes capsulatus*. The controls in distilled water lost from 2 per cent to 3 per cent. These three acids are probably produced during the action of some anaerobes (for example, the gas bacillus) upon meat. It is possible that the erosion of the bone is due to these substances.

Therefore, although it would appear to be impossible to sterilize bone sinuses by antiseptics, the erosive action of acids may be utilized in a dressing solution. The use of a solution such as 1 per cent acetic acid may hasten the disappearance of the sequestra and so destroy the focus of infection.

*Bone Sinuses*—The presence of organisms within the dead bone (whether in sequestra or in portions still attached to living bone), rather than in the soft tissues, is probably the cause of the persistence of the sinus and the



occurrence of the acute recrudescences of infection, or "flares," after secondary operative procedures. By the gradual erosion of a sequestrum at the bottom of the bone sinus, as well as by the outgrowth of bacteria from this nidus of infection, continual reinfection of the sinus tract must occur. The closing of the sinus cannot be accepted, however, as proof that the sequestra have disappeared and the bone become sterile. Growth was obtained from sequestra removed from two cases in which the sinus had been completely closed for two weeks or more. This persistence of bacteria shows the necessity of caution in undertaking at an early date operations, such as bone grafting or nerve suture, where asepsis is a primary necessity.

It should be remembered that the sequestra form only a portion of the dead and infected bone present about the fracture. Many small devitalized portions which have not yet become detached from the living bone are probably heavily infected and are undergoing the same process of erosion as the sequestra themselves. This is the probable source of the infection which is one of the causes of failure in the grafting of bone upon old fractures.

*Flares*—The cases classified as "flares" have been those which showed a rise of temperature within 24 hours of the operation (sequestrectomy), amounting to one degree or more of fever, continuing for 48 hours or longer and associated with a local inflammatory reaction about the wound. This reaction may probably be regarded as evidence of a temporary acceleration of growth on the part of the organisms freed by the crushing of bone and callus incident to the operation, and the absorption of the toxic products of their growth in the blood and serum left in the fresh operative wound. Absorption is, of course, facilitated by the operative trauma to the soft tissues.

About 39 per cent of the 48 cases studied in this series showed the reaction defined as a "flare." Nearly twice as many flares occurred in the older cases as in the newer, as represented by a percentage of 58 in the cases of more than 120 days as against 32 in the cases of less than 120 days (Table II). It is possible that the older cases were originally of a more severe type, although this could not be substantiated by an examination of the histories. The older cases may have become more delicately sensitized to the proteins of the bacteria infecting the wounds, and the temperature reaction may have been of an anaphylactic character rather than a direct toxic reaction. This, however, seems improbable, since the majority of the cases ran a temperature course lasting several days and usually giving *local* symptoms of a renewed acute infection. The reaction cannot be satisfactorily explained by any difference in post-operative treatment or lack of treatment. All the cases were placed immediately after operation either upon the Carrel-Dakin technic or upon simple dry dressings. A much higher percentage (88.5 per cent as against 40.6 per cent) of those on the Carrel-Dakin technic showed the flare reaction than those on dry dressings.

Table III shows a comparison of the flare cases and those showing the normal reaction after operation. The great preponderance of the anaërobic flora of the bone in the flare cases is apparent.

# BACTERIA WITHIN SEQUESTRA

TABLE III

PERCENTAGE INCIDENCE OF VARIOUS GROUPS OF BACTERIA IN SEQUESTRA OF NORMAL AND "FLARE" CASES

Group of organisms	Aërobes				Anaërobes	
	Staphylococcus	Streptococcus	Small Gram-negative bacilli	Small Gram-positive bacilli	Gas-forming bacilli	Spores
Normal after operation—26 cases	68	86	73	45	40	23
Flare after operation—22 cases	55	75	75	60	70	50

*Relation of Anaerobes to Flares*—Now there was a greater proportion of anaerobes in the old cases than in the new, and also a greater number of flares. Were the anaerobes the cause of the flares?

Since the greater incidence of anaerobes in the flare cases might be considered merely an apparent one due to the fact that most of the flares are included in the group of old cases (Table II), it is advisable to consider the groups of old and new cases separately. Table IV shows the flora of the flares and non-flares of each group.

TABLE IV

PERCENTAGE INCIDENCE OF ANAEROBIC BACTERIA IN SEQUESTRA COMPARED AS TO AGE OF CASE AND REACTION AFTER OPERATION

Reaction	New cases		Old cases	
	Percentage incidence of		Percentage incidence of	
	Gas-forming bacilli	Spores	Gas-forming bacilli	Spores
Normal after operation	33	13	56	42
Flare after operation	71	57	80	58

It appears from the table that anaerobic gas-producing bacilli and spores occurred much more often in the flare cases than in the non-flare, *independently of the age of the case*. Furthermore, the predominance of anaerobes in the flare cases over that in the non-flares is greater in the group of new cases than in the old.

Three cases were of special interest in respect to the causal relation of the anaerobic flora to the flare. The first case was operated upon twice with an interval of about two weeks. A flare followed both operations and sequestra removed on each occasion showed spores and gas-producing anaerobes. The second case was also subjected to two operations for removal of sequestra at about two weeks' interval. After the first operation no flare occurred, and no gas-producing bacilli or spores were found in the sequestra removed. After the second operation, two weeks later, a sharp flare occurred, and sequestra removed and examined showed spores and gas-producing anaerobes. The third case underwent three operations with intervals of

about ten days between each. No flare followed either of the first two operations, nor were spores or gas-forming bacilli found in the sequestra, but a sharp flare followed the third operation and a heavy growth of gas-forming spore-bearing anaerobes was obtained from the sequestra removed.

## SUMMARY

Aërobic and anaerobic bacteria invade the bony substance of nearly all sequestra and remain there as long as the sequestra persist.

Gas-forming, spore-bearing anaerobic bacilli, usually the *B. aerogenes capsulatus*, *B. malignans oedematis* and *B. Hibler IX* types, persist longer within the bone than in the wound about it. They were never recovered from the wound when absent in the sequestra. Nests of these anaerobes may persist for some time after the wound is completely closed.

Anaerobic bacilli are probably active factors in the disintegration of sequestra within the wound.

Anaerobic bacilli *within* the dead bone appear to be associated with the occurrence of "flares" after operations on bones.

Flares occurred more frequently after sequestrectomy when the cases were over 120 days old than when the cases were under that age.

It is probably impossible to kill by antiseptic treatment the bacteria within the dead bone. The object of treatment must be to remove this focus of infection. The sequestra may be extracted by operation, or their disappearance hastened by utilizing the solvent action of *acid* dressing solutions.

The persistence of bacteria within the bone probably explains the infection which often follows bone grafts in old compound fractures and indicates the advisability of postponing that operation as long as practicable.

We take pleasure in acknowledging our indebtedness to Dr. Joseph A. Blake, Surgeon-in-Chief of the hospital, and to the Surgical Staff for their cooperation with the laboratory in these investigations.

# DIABETES INSIPIDUS AS A SEQUEL TO A GUNSHOT WOUND OF THE HEAD

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THE following case is of interest because it seems to bring additional support to the idea that diabetes insipidus is an expression of a disturbance of function of the hypophysis or its neighboring tissue. So far as I have been able to learn from a survey of the literature it is the only case in which the occurrence of marked polyuria without sugar has been observed after a head injury of this type. Doubtless the European war will bring out records of many more cases of a similar nature.

Mr O, aged forty-six years, was brought to the hospital on March 29, 1916, by Dr Arneson, of Scarville, Iowa, suffering from a gunshot wound of the right temporal region which had been self-inflicted about fourteen hours previously. An X-ray examination of the head disclosed comminuted fractures of the right temporal and left frontal bones and a bullet lying subcutaneously in the left frontal region. There was such extensive extravasation of blood around both eyes that they could not be opened. There was also bleeding from the mouth and nose. The patient was unconscious, but restless. There was no evidence of paralysis. An immediate operation was performed under light anæsthesia for the purpose of providing adequate drainage of the wounds and of removing the bullet. The total duration of the operation was eighteen minutes. In the twenty-four hours following the operation only 14 ounces (448 c c) of urine passed, which were obtained by catheter. On the fourth day the patient became partly rational, and it was discovered at that time that he was totally blind in both eyes, although no lesion of either eye was evident. From then on the total amount of urine passed during the twenty-four hours increased enormously. Because of frequent urinations in the bed, it was impossible to measure accurately the total amount of urine passed on any day. But on April 10, in addition to three urinations of large amounts in bed, 139 ounces (4½ litres) were voided. A sample of this urine showed a slightly acid reaction, a specific gravity of 1002, and no abnormal constituent. On April 12 the amount of urine which could be collected totalled 170 ounces (5½ litres). An analysis of this urine was similar to that of April 10. The enormous polyuria, accompanied by polydipsia, remained a prominent feature of the case until his discharge on April 18. His condition had constantly improved. But his mentality never became normal and his blindness remained complete. He became so unmanageable that he was transferred to the State insane institution at Cherokee, Iowa.

The total blindness which developed following the gunshot wound was almost certainly due to cutting or destruction of both optic nerves. From the direction which the bullet took it is probable that the optic nerves were cut at the chiasm. Such injuries have been repeatedly described in association with gunshot wounds of the temporal regions. Repeated attempts were made by Dr F G Murphy to examine the fundus of the eyes to ascertain the presence of optic nerve atrophy, but the irrational mental condition of the patient made such an examination impossible. A wound sufficiently near the hypophysis to involve the optic chiasm could easily affect the hypophysis, if not at first, at least by subsequent swelling of the parts or a contracture of scar tissue. It seems probable, therefore, that the polyuria was induced by injury to the hypophysis. The fact that it appeared four days after the injury would indicate that the hypophysis had not been injured directly by the bullet, but rather by the reaction which occurred in the region. It has so far been impossible to learn whether the polyuria has persisted.

The discovery by Magnus and Schaefer<sup>1</sup> in 1901 of the diuretic action of a watery extract of the posterior lobe and pars intermedia of the hypophysis directed attention in a striking manner to the relationship which exists between disturbances in that gland and diabetes insipidus. E Frank<sup>2</sup> in an important article published in 1912 reviewed the literature then existing on the subject and made a strong plea for a consideration of the relationship between the hypophysis and diabetes insipidus. Numerous writers already had emphasized the fact that lesions of the brain which involved the vicinity of the hypophysis were often accompanied by polyuria without sugar. Oppenheim<sup>3</sup> in thirty-six cases of basal syphilitic meningitis observed polyuria in twelve cases. Two of these showed at autopsy a gumma of the optic chiasm and hypophysis. Kruse<sup>4</sup> in a study of thirty cases of bitemporal hemianopsia observed diabetes insipidus in seven, and Spanbock and Steinhaus<sup>5</sup> mention its occurrence in eleven of fifty cases of bitemporal hemianopsia. Polyuria associated with metastatic carcinoma involving the hypophysis or its region, secondary to carcinoma of the breast, is a fairly frequent occurrence. Cases have been reported by Simmonds,<sup>6</sup> Rosenhaupt,<sup>7</sup> Miller,<sup>8</sup> and von Gierke<sup>9</sup>. Recently Sekiguchi<sup>10</sup> has described two additional cases. Cushing's<sup>11</sup> experiments in 1913 led him to conclude that there was a strong "argument in favor of the view that an actual disturbance of the pituitary body itself, rather than the stimulation of some predicated diuretic centre in the remote third ventricle surmounting the growth, was the inciting cause of a condition worthy of the designation of diabetes insipidus." Lewis and Matthews<sup>12</sup> in 1913 concluded from their experiments that diabetes insipidus is probably dependent on the hypersecretion of the diuretic substance of the posterior lobe which is secreted by the epithelial covering known as the pars intermedia. Falta,<sup>13</sup> however, warns against a too hasty conclusion that lesions of the base of the brain which induce polyuria do so always by mediation of the hypophysis, although he discusses at length the possibility that such may be the case.

## DIABETES INSIPIDUS AFTER HEAD WOUND

Several cases of diabetes insipidus of which the onset occurred after a trauma to the head are in the literature. Doubtless, at least a temporary polyuria will be found to be very common after head injuries, especially basal skull fractures, if attention is more frequently directed to the output of urine. Mohr<sup>14</sup> has recorded a case which developed about three weeks after a basal skull fracture, and Kleeblatt<sup>15</sup> described one occurring on the third day after a similar lesion. French and Ticehurst<sup>16</sup> also observed a case of diabetes insipidus which had its origin in a fracture (through the sphenoid).

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# TRAUMATIC BRACHIAL PARALYSIS WITH FLAIL SHOULDER JOINT

WITH A REPORT OF THREE OLD AND ELEVEN NEW CASES

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IN a series of papers, published during the past five years, the effort has been made to show that traumatic brachial paralysis may be due to injury of the shoulder joint without actual trauma to the nerves supplying the limb involved. The chief evidence offered consists in the recovery of normal power merely from restoring normal function to the shoulder joint. If the shoulder joint relations are normal, the treatment consists in measures to overcome the limitation of movement always present in the shoulder joint. If the shoulder joint relations are abnormal, the treatment consists first in restoring them to the normal and then restoring the normal motion. The abnormal relations are due to dislocations. In the adult we have to deal usually with the ordinary anterior, subcoracoid dislocation, in the new-born with the posterior subluxation. In adults there occurs, not infrequently, a dislocation in which the humeral head drops below its normal level and the joint usually becomes flail. The purpose of this paper is to confirm, by further clinical experience, the conclusion reached in the first paper<sup>1</sup> on this phase of traumatic brachial paralysis, *ie*, that the flail shoulder joint is the result of such a dislocation and is essentially the cause and not the result of the paralysis. This is shown by the fact that the early operative removal of the flail shoulder results in a cure of the paralysis.

While the degree of paralysis and pain has varied considerably in my fourteen cases, one feature has been constant, the falling of the upper end of the humerus from a half to an inch below its normal level under the acromion. One type is more common than the others, although this varies in the degree of paralysis associated. The fingers can be pressed between the head of the humerus and the acromion, but this separation is easily removed by pressure upward under the elbow. As soon as the pressure is removed, however, the relaxed condition of the joint recurs. The patient can, usually, lift the humerus up to its normal level by a little muscular effort, but as soon as this effort is relaxed the humerus falls again. The muscles progressively atrophy until finally the upper end of the humerus may become almost subcutaneous. Usually, the movements and power of the hand are very good and may be almost normal. But the power decreases as the shoulder is approached and there it may be almost nil. In two cases the shoulder joint was tensely filled with effusion and not flail. I have had one case with complete paralysis of the whole limb and one with almost complete paralysis, in both of which

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\* Read before the Philadelphia Academy of Surgery, May 7, 1917

<sup>1</sup> The Journ Nerv and Ment Dis, vol 38, No 4, April, 1911, p 193

there developed a painful stiffness of all the joints of the limb involved. There is reason to suspect that much of the apparent paralysis was due to this pain and limitation of movement of the muscles and joints. Both died within a year and a half after the injury, and at the time of death the paralysis had disappeared in both, the stiffness and pain had improved very much but had not entirely disappeared and was still very severe in the hand.

As already stated the purpose now is not to discuss further the probable mechanism of the joint injury, but to support it by the results of treatment based upon it, and to outline that treatment. A very brief reference to the mechanism is necessary to properly appreciate the purpose of the operation. The most common cause of injury to the shoulder joint is hyperabduction from excessive force in a fall on the hand or grasping some object with the hand to prevent the fall. Rarely the force is sufficient to tear away the capsule and tendinous attachments from the neck of the humerus all around, when from this loss of support the humerus and the rest of the limb may sink downwards until the surrounding attached structures take up the support. The gap intervening between the lacerated surfaces later fills in by cicatricial tissue. While this is taking place this gap is maintained on the upper outer side of the joint where the capsule is under tension, but is not maintained on the axillary side where the torn edges of capsule come together because on this side the capsule is relaxed. This results in a lengthening of the capsule on the upper outer side and a contraction on the inner side. The outer lengthening permits the humeral head to drop when the arm is at the side. Because of the axillary contraction when the arm is carried into abduction the humeral head is forced up firmly to its normal level under the acromion. For the same reason complete abduction is prevented, notwithstanding the flail point. The humeral head probably can never go back to its normal level under the acromion against gravity with the arm at the side, and the patient ever afterwards suffers from the abnormality in the joint. To show the separation between the acromion and upper end of the humerus, the X-ray must be taken with the patient in the upright position. That this joint condition is the cause of the paralysis is proven in recent cases by the fact that when the joint is restored to its normal condition and is used long enough the power returns in the muscles. The normal joint conditions have been restored merely by shortening the upper and outer abnormally lengthened portion of the capsule by means of an operation and afterwards removing the operative stiffening of the joint by proper exercises.

In the shoulder as in most joints, a satisfactory exposure of the capsule without excessive division of muscles is very difficult and will, probably, deter many from trying this method of treatment. I have varied the operation in minor details in the effort to discover the easiest and simplest method, and I am not yet prepared to describe a single operation and exclude the other variations. I have presented a brief outline of each one in the case reports. Unless the surgeon is unusually familiar with the anatomy of the



part, I would advise the operation described in connection with Case IX. The incision follows the McBuiney principle and gives a limited exposure of the capsule, but with a little patience and care it is sufficient for the purpose. As no capsule sutures (they are very difficult to introduce) are employed, it will be well to fix the arm after operation in the position shown in Fig 7 and maintain it there for about five weeks. Unless the patient is willing to persist for a long time after the operation in exercises to force the arm into full abduction and external rotation, as by hanging by the hands, there will be much danger of permanent stiffness of the shoulder joint. Upon the rapidity with which the motion returns and the frequency with which it is used, depends in a large measure the rapidity and completeness with which the power of the muscles return. Yet complete or almost complete return of power seems to be possible when a considerable stiffness of the shoulder becomes permanent, as in Case IX.

#### CASES PREVIOUSLY REPORTED

CASE I—Man, thirty-nine years old. April 9, 1909, fell on board ship, a height of 8 ft., on his left side, while under the influence of liquor. Did not notice anything wrong with his shoulder until the following morning when it was stiff and painful. Admitted to the Philadelphia General Hospital April 10, 1909, on the service of Dr J Chalmers DaCosta who kindly turned the case over to me. I examined the patient for the first time about six weeks after the accident and found a severe brachial paralysis with flail shoulder, the paralysis being most severe at the shoulder and gradually becoming less toward the hand which was normal. Operation June 4, 1909. Incision along the posterior margin of the deltoid. Distinct evidence of old fractures of greater tuberosity found. Posterior scapular muscles lifted from the capsule, which was incised midway between its glenoid and humeral attachments with overlapping of these margins by catgut sutures. External rotator muscles also shortened by a tuck in each with catgut sutures. Wound closed with temporary drainage for oozing, and arm fixed on splint at right angles with body and in full external rotation. Primary healing. Arm brought to side in two weeks and supported for another week. Massage and exercises to improve motion at shoulder. In three months power of limb and motion at shoulder practically normal, and these have remained normal ever since. This patient has been available for observation almost continuously since the operation, as a fireman at the Philadelphia Hospital. The foreman says this patient is his best workman.

CASE II—Woman, twenty-five years of age. On December 2, 1910, on taking her seat in a rocking chair, she raised her arms above her head in the act of "stretching," when the chair suddenly tilted backward, necessitating a sudden and vigorous effort to recover her balance. This produced a severe pain which she located in the middle of the arm about over the insertion of the deltoid. A little later she tried flexion and extension of the forearm to "take the catch out of the arm," but without success. She went to the theatre the same



FIG 1—Case I Before operation. Paralyzed left arm shows some atrophy and a slight notch on the point of the shoulder indicating the dropping of the humerus from its normal level under the acromion. Compare with normal right shoulder, and with same shoulder in Fig 2. C, clavicle, A, acromion, S, abnormal space between humerus and acromion, H, head of humerus.

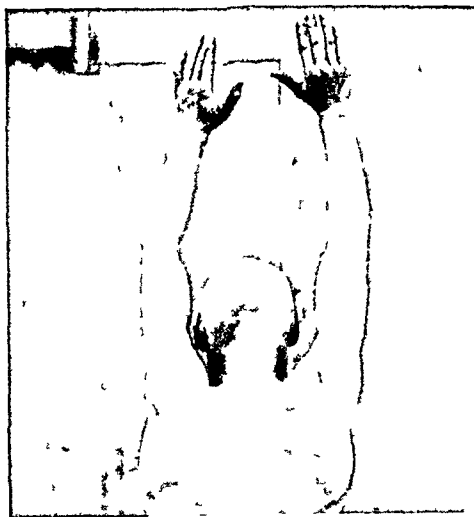


FIG 2—Case I Picture taken in 1914, showing good muscular development of left upper extremity, which is as good to-day.

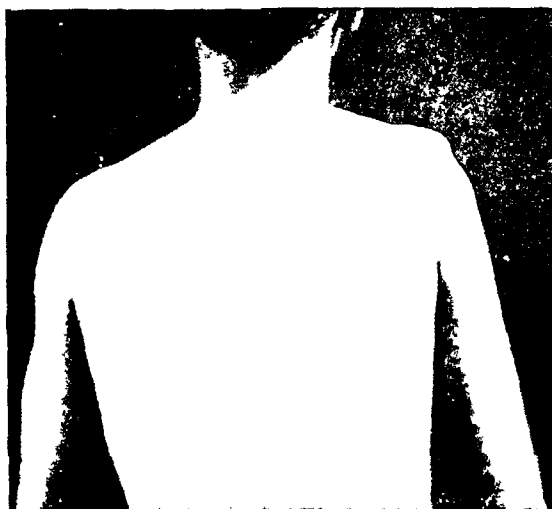


FIG 3—Case V Posterior aspect of shoulder in a typical case of traumatic brachial paralysis with flail shoulder-joint.



FIG 4—Shows that a flail shoulder-joint, once developed, however slight, probably never can fully recover because the humeral head cannot go back to its normal level against gravity. A and C, normal right shoulder. B and D, affected left shoulder. A and B taken March 4, 1916, about seven and a half months after beginning of trouble. By directing the X-rays in the plane of the acromion process the widest possible space was obtained between the acromion and humeral head, thus emphasizing the difference between the two shoulders. C and D were taken May 5, 1917, fourteen months after A and B, the X-rays being directed in the same plane in all four pictures. The left shoulder has lost none of its laxity, which is probably, permanent.

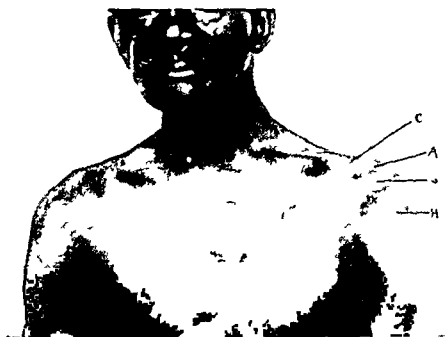


FIG 5—Case XII. Falling of humerus and consequent hollow between the acromion and head of the humerus shown in the left shoulder. C, clavicle. A, acromion. S, abnormal space between humerus and acromion. H, head of humerus.

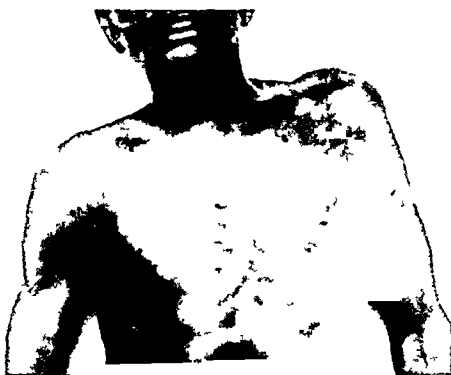


FIG 6—Case XII. Before operation. Degree of active abduction possible. This slight degree appears to be due to fixation of the shoulder-joint and turning of scapula by muscles of neck and trunk and not to any action of the deltoid. Note that the hollow between the acromion and humeral head has disappeared. This usually happens on any movement or attempted movement of the arm. Cannot flex elbow in slightest degree.



FIG 7 —Case XII. A very good position in which to dress the arm after operation. It should never be dressed at the side. Tightening of the axillary portion of capsule from abduction forces upward head of humerus, while the portion operated is relaxed and shortened by cicatrization.



FIG 8 —Case XII. Shows abnormal space between acromion and humeral head. X-rays directed anteroposteriorly not in plane of acromion as in Fig 4. Fracture of greater tuberosity found at operation not found in this X-ray. Long tendon of biceps detached from upper glenoid margin in this case, but falling of humerus no greater than usual on that account.



FIG 9 —Case XII. Taken May 20, 1917, about a half minute after releasing his grasp of a tree limb by means of which he forced the arm into its full limit of abduction. He could keep it there against the pull of the contracted axillary tissues about a full minute. 1, posterior operation scar, undergoing keloidal change.



evening, but came home early on account of pain. Swelling appeared on the following day and the pain and tenderness became so severe that she could not tolerate any handling of the part. The arm hung at the side helpless, except for the ability to make slight abduction. She went to bed on the day following the accident and remained there three weeks, but could not lie down on account of the pain. Twenty days after the accident she was etherized and a persistent effort was made by her physician to reduce what seemed to be a dislocation, but without success. I saw the patient for the first time at the University Hospital, on the thirty-fourth day after the accident, when she was compelled to sit up in bed most of the time and was unable to move the arm, except for a few degrees, in any direction. The head of the humerus was distinctly below its normal level with an abnormal depression between it and the acromion. Pressure upward caused severe pain at the shoulder. Measurement from the acromion to the external condyle showed lengthening of five-eighths of an inch on the affected side, and the X-ray showed a decided downward displacement of the humeral head, but no fracture of the greater tuberosity. Operation January 6, 1910. Incision through posterior fibres and not along posterior margin of deltoid as in preceding case, and capsule alone shortened. The most prominent symptom in this case was the pain, which was explained by the marked tension of the capsule before it was opened, and the escape of much dark grumous blood as soon as it was opened. Eight months after operation the patient reported that the arm was perfect except that she still could not hook up her skirt in the back. This difficulty disappeared later and she has engaged much in tennis and other athletic games, without the slightest trouble ever since.

CASE III —Coipulent man, sixty-five years of age, subject to severe cardiac weakness and, therefore, not suitable for operation. On October 28, 1909, while attempting to catch a street car, he tripped and fell against the curb, striking on his right shoulder. When he got up the arm seemed helpless and felt as though it was asleep. He went home and lay on a sofa, soon falling asleep. When he awoke both arms were raised above his head, causing him to think there could not be much wrong with his injured shoulder. On the following day it was stiff and painful and he went to a hospital, where the shoulder was said to be dislocated and reduction accomplished, the arm being bound to the side and the wrist supported by a sling. He was an orderly at the Philadelphia Hospital, and on his return there the dressing was reapplied and the limb maintained in this position for a month. He says that for a long time after this the arm hung helpless at his side. He could flex the forearm slightly but required the aid of the other hand to complete the movement. The hand movements were always best and he could always write with it, provided the forearm were first brought to a resting position. He had had electrical treatments at different times but thinks they never did him any good. Examination, August 30, 1910, shows that he has good movement and power in the hand. The forearm can be flexed much better now than

some months ago, but not nearly as well as on the normal side. The arm by a strong effort could be abducted about 20 or 30 degrees, but with a considerable elevation of the shoulder (as in Fig 6), and it was held there with some effort and pain at the shoulder. There is marked atrophy of the deltoid and posterior scapular muscles. Passive abduction is nearly normal. There is a distinct hollow between the acromion and head of the humerus, into which the fingers can be inserted. By pressure upward under the elbow, the humerus can be pushed up to its normal level and the patient can produce the same effect by muscular effort, but as soon as he relaxes, the humerus drops again. Measurements on both sides show a half-inch lengthening on the affected side. There is crepitation in the joint on movement but the X-ray is not clear as to the existence of a fracture of the greater tuberosity. Electrical examination by Dr J W McConnell. On the right or affected side, the trapezius, biceps, extensors and flexors of the hand, the supinator longus and pronator teres, react normally to faradic stimulation. A current sufficiently strong to provoke contraction in the muscles by diffusion of the current, fails to cause any contraction of the deltoid. The muscles of the left shoulder and arm respond normally to faradic stimulation. This patient died of heart disease June 10, 1911.

## NEW CASES

CASE IV—Woman, single, fifty-eight years old, house servant. Admitted to the Philadelphia General Hospital, May 27, 1911, in the nervous wards, on the service of Dr J Hendrie Lloyd. Her chief complaint was of loss of power with tingling sensations in the whole left upper extremity. The patient was perfectly well when, several days before admission, she fell from a chair, on which she was standing, and struck on her left elbow, arm and shoulder. The tingling sensation is most marked in the fingers. She says that immediately after the fall the left arm lay under her body and that she could not move it except by grasping it with the right hand and pulling on it. She says "it felt as if it were dead" at that time.

Summary of examination by Dr Lloyd Gait and station good. Eyes negative. Pupils and cranial nerves good. Tongue protrudes in median line. Has slight tremor. *Right upper extremity* showed grip, power and motion unimpaired. Slight tremor in hand. *Left upper extremity* showed complete loss of power and motion and absolute flaccidity. Reflexes in biceps, triceps and pectoralis major absent. Tingling sensations in left arm, forearm and hand. Sense of touch and pain diminished, but not entirely lost in any part of the limb.

Dr Lloyd asked me to see the case and to operate on it if in my judgment it was advisable. I found a distinct relaxation of the shoulder joint and the sensation unexpectedly good throughout the whole limb, and in view of the remarkable results obtained in the two preceding cases from simply restoring the normal shoulder joint relations and forced movements afterwards, I concluded to do the same operation in this case. I had not dealt with a complete paralysis

## TRAUMATIC BRACHIAL PARALYSIS

before There was in addition in this case marked pain on movement of all the joints and a certain degree of cyanosis of the affected hand as it hung at the side

Operation done July 1, 1911 Incision about five inches long along posterior margin of the deltoid, which was freed from the underlying external rotator muscles and retracted strongly upward, while the humerus was rotated strongly outward The infraspinatus muscle, the first below the spine of the scapula, was separated from the shoulder joint capsule underneath, and the supraspinatus as far upward as possible The capsule was then divided parallel with the glenoid margin and about midway between the glenoid and humeral attachments of the capsule No signs of fracture or other injury discovered in the joint, except that capsule was abnormally long above The circumflex nerve was exposed in the lower part of the wound, including a few of its branches It was pinched with a tissue forceps several times without any response in the deltoid With the arm held in abduction to about a right angle and external rotation, the capsule wound edges were overlapped by several catgut mattress sutures Silk-worm gut for skin sutures Small rubber dam drain in upper angle of wound for uncontrollable oozing (most dependent position with patient lying on her back) Right-angled splint applied to inner side of arm and side of body, firmly, by adhesive plaster and bandages with arm in full external rotation Primary healing Drain removed in 48 hours All support of arm and shoulder removed July 19, and arm gradually brought to side in a few days, after which it was supported by an adhesive strip under the elbow and over the acromion, with a sling for the forearm from the neck

The return of power was very slow in this case and was associated with a very troublesome painful stiffness in all the joints July 19, with the forearm resting on the patient's knee, there was very slight power to pronate and supinate the forearm July 23, index finger could be moved slightly Very slight dorsal flexion at the wrist Pronation slightly improved Can abduct elbow about four inches from the side Some stiffness observed in all joints of the limb for the first time (It may have been, and probably was, there before operation) September 1, abducts arm about 25 degrees Elbow cannot be passively extended more than about 140 degrees and in this position the arm hangs at the side From this position she can flex the elbow to slightly more than a right angle Can pronate and supinate forearm through a range of 10 to 15 degrees, and this with some force, supination being stronger than pronation Has considerable flexion at wrist but less extension Can touch side of index finger with thumb and can approximate thumb to within a half inch of little finger Has considerable movement of all fingers but cannot begin to make a fist

Left hospital September 9, 1911, because she would not tolerate the pain induced by attempts at massage and passive motion to improve the very crippling stiffness and pain in all the joints of the limb

By May 21, 1912, she had made remarkable improvement She could actively abduct the arm at the shoulder to somewhat beyond a



right angle with the body and with the aid of the other hand could force it almost into full abduction. She had almost full flexion and extension at the elbow, and almost full pronation and supination of the forearm. The wrist movements had improved much, but she still lacked any considerable movement in the finger joints, and had most in the metacarpophalangeal joints. She was very anxious to go back to her work as a house servant, but the condition of her fingers would not permit her to do so. She was found dead in bed July 1, 1912. There was some reason to suspect suicide.

This is one of the most interesting cases I have had. The complete paralysis from the moment of the fall and the feeling as if it were then "dead," suggested very strongly the presence of a severe rupture of the brachial plexus. The preservation of sensation throughout the limb and the later complete disappearance of the paralysis, prove that a plexus rupture had not occurred. This patient was shown before the Clinical Congress of Surgeons, at the University Hospital in 1911, and at that time there was no suggestion of a brachial paralysis, only the evidence of a multiple joint condition.

CASE V—Sailor, admitted to service of Dr. H. Siter at University Hospital, March 2, 1911. He had sustained on board ship a fracture of the neck of the left femur and a dislocation of the right shoulder which had been reduced soon after its occurrence. The shoulder became very stiff and painful and the arm very weak and helpless. Dr. Siter asked me to take charge of the affected shoulder and arm. On June 8, 1911, under ether, the arm was forced into nearly full abduction and external rotation and held in this position for three weeks. The cast was then removed and the arm allowed to come down to the side of the body gradually, after which exercises were employed to restore normal motion to the shoulder joint. For a time he seemed to be making satisfactory improvement and was discharged to return to the hospital for the exercises. A short time later he reported that the arm was not improving but losing in power. He was readmitted to the hospital August 3, 1911, when the following notes were taken. There is still considerable atrophy of the whole right upper extremity, the shoulder region and hand being most affected. Can abduct the arm at the shoulder about 30 degrees. Can flex and extend elbow and rotate forearm. Can close fist only to about a quarter of the normal, and must have the wrist in dorsal flexion to do this. There is a considerable depression between the acromion and head of the humerus (see Fig. 3), which can be made to disappear by pressure upward at the elbow. Measurement from the edge of the acromion to the external condyle shows on the left side  $12\frac{1}{4}$  in. and on the right side 13 in. There is much atrophy of the hand and considerable atrophy of the rest of the limb.

Before my manipulations under ether he had the common type of traumatic brachial palsy without flail shoulder. He afterwards developed, evidently as a result of my manipulations, a typical case with flail shoulder. On August 5, 1911, I did the operation described in connection with Case IV. Primary healing. Right-angled splint re-

moved August 20, and arm allowed to work gradually to side in the following few days. Arm supported by adhesive strip under elbow and over acromion, and arm bound to side from August 26, when he was allowed out of bed, until September 1, when he was discharged from the hospital. At that time he showed considerable improvement in power of the limb since the operation and could close the fist of the affected side almost completely. I found it unusually difficult to keep in touch with this case afterwards. He refused to keep up treatment at the orthopaedic gymnasium, for the stiffness of the shoulder which always results from the operation. He had a prospective suit for damages against the ship company on his hands and there was some reason to suspect that his arm was recovering too rapidly without special treatment. I was concerned now only about the stiffness of the shoulder and repeatedly urged him to force the shoulder movements before it was too late. His reply was "The arm is coming around all right, now." After the successful termination of his suit for damages, he left the city for his home in Germany, where he has since remained.

CASE VI—Man, seventy years old, huckster. While helping to "break in" a pair of horses May 14, 1913, he was thrown violently against the pole of a wagon, striking against the left arm. He was admitted to the Philadelphia Hospital, the same day, on the service of Dr. A. C. Wood, with whose permission I operated on and am reporting the case. There was a laceration of the right eyebrow and one on the left side of the nose. On the following day the whole left upper extremity was swollen, the shoulder region excessively, and there was much pain in all the joints. A dislocation of the shoulder was reduced by Dr. Wood. The X-ray showed a fracture of the external condyle and a possible fracture of the head of the radius. Flexion of the elbow was distressing because of the swelling and pain and the arm was bound to the side with the elbow in extension on an anterior splint. The swelling of the hand which was not included in the bandages continued to be severe. The bandages and splint were not removed until May 23, when the whole limb was observed to be almost completely paralyzed. On June 11 it was noted "that paralysis continues but there is slight movement in his fingers and slight rotation of the forearm. The humeral head drops slightly below its normal level, which is shown by the X-ray, and the shoulder joint is somewhat lax."

Neurological examination by Dr. Charles Potts, June 17. Arm can be abducted by force to angle of about 20 degrees. Forearm can be supinated only to midway between full supination and pronation, from the fully pronated position in which it usually lies. Voluntarily the arm cannot be elevated at all in any direction. Can rotate arm at shoulder slightly. No winging of scapula is present. Unable to flex forearm on arm, and attempt to do so with force, passively, results in flexion scarcely to a right angle. Can extend pronated hand to little above line of forearm. Can extend first phalanges on hand but not second and third. Can flex hand on wrist, but no power of deviation to either radial or ulnar side. Can flex first phalanges but not second and third. Some power of abduction of fingers but not of adduction. End of thumb cannot be approximated to any of fingers.

Unable to flex or extend end of thumb No biceps jerk Triceps jerk is slightly present Wrist jerks are absent Muscles of forearm and arm are atrophied Hand is swollen and œdematous Impossible to see whether intrinsic muscles of hand are atrophied On little and ring fingers there is loss of pain sense On dorsum of hand as far as wrist, on line with little and ring fingers, pain sense is diminished Otherwise pain sense is everywhere intact Electrical examination by Dr Potts, June 23, 1913 Infra- and supraspinatus of left side respond slightly to a strong faradic current Pectoral response O K Latissimus dorsi responds faintly None of other muscles of arm respond at all to faradism Absence of faradic contractility shows impairment in the nerve supply of these muscles On the basis of these findings Dr Potts's diagnosis was, *brachial nerve paralysis*

The same operation as in Case IV was done on the left shoulder on June 24, 1913, and arm fixed at right angles with body on splint Patient says two days later, June 26, "the left hand now seems alive," and that before operation it felt "numb and dead" There is already a slight but distinct improvement in the movements of the hand, but it is general and, therefore, not easily described Swelling of hand distinctly less and impaired sensation over dorsum of hand also lessened Patient says he has now normal sensations on the left as on the right side July 14, for past few days had been allowing his arm to fall from the splint and to come to an angle of about forty-five degrees with the body To-day it is fixed in this position with a suitable splint Hand and forearm still show some swelling Moves all fingers actively at the first joints much more freely than before operation, and slightly at the second joints, but not at all at the third

The stiffness and pain in all the joints of the limb seen in Case IV were characteristic of this case also, and were also much worse in the hands than elsewhere In Case IV, the paralysis was complete, while in this one it was almost complete The recovery from the paralysis was likewise very slow in this case, and when this patient died, January 9, 1915, it had completely disappeared, the limb at that time being in practically the same condition as the affected limb in Case IV at the time of her death In neither of the two cases could death have been due to the operation on the affected limb

Le Breton<sup>1</sup> calls attention to what appears to be the same condition affecting the hand after Colles's fracture In his last paper<sup>2</sup> he includes among his case reports a reference to this patient whom he saw when I exhibited him before the members of the American Orthopædic Association, at the University Hospital, June 17, 1914 Two of my later cases were more mildly affected than this one and Case IV, and I have seen it several times in shoulder injuries without flail shoulder joint Le Breton attributes the condition to a multiple arthritis of the hand in his cases, although he says there was a dense œdema and a low-grade cellulitis I am confident that in my shoulder cases all the tissues from the shoulder to the ends of the

<sup>1</sup> Amer Jour Orthoped Surg, November, 1911

<sup>2</sup> Surg, Gynec and Obst, 1915, xx, 450

fingers were involved in the pathological process, as shown by a marked tenderness in all parts pressed on. Restricted motion in the joints was the most evident sign of the condition. It slowly becomes less acute and finally the pain and tenderness disappear, but leave a serious restriction of movement in all the joints of the part involved. I have not yet seen perfect movement recovered in any of the joints, although the larger joints have recovered much. But the hands, in both of my cases that died about a year after the accident, were at that time practically useless. I have no idea of the cause of the pathological process at the bottom of this condition, but I suspect that there is from the site of injury to the ends of the fingers a low grade of inflammation with exudate which affects the muscles and other soft tissues, but the synovial cavities most seriously. The numerous joints of the hand and the more extensive synovial lined tendon sheaths may become the seat of infiltration and adhesions which could account for the very troublesome involvement of the hand. Le Breton refers to some formation of adhesions in the tendon sheaths. There is room for question as to whether well developed adhesions between the tendons and their sheaths in the fingers will ever disappear and permit free movement of the tendons in their sheaths again.

CASE VII—Man, physician, referred September 12, 1913, by Dr. T. H. Weisenberg. Strong and healthy except for trouble in right upper extremity. In October, 1905, he was riding on a railway train, being seated near the window and the only passenger in the seat. His train was going westward and was being passed by an east-bound train. Both engines were taking up water at the time from troughs between the tracks underneath. The water thus disturbed was thrown through the window into the patient's face. This startled and confused him and during the excitement he was injured in some manner, becoming unconscious. He did not recover consciousness until 18 hours afterward when he was in the Altoona Hospital. His neck was stiff and he had slight swelling at the base of the skull in the occipital region. His chief trouble was in the right upper extremity. The whole limb was very painful but showed little swelling. Sensation was not tested and he does not know whether it was disturbed or not. The limb was paralyzed but not completely, and as far as he can recall about the same parts of the limb were involved as now. About five or six days after the accident a dislocation of the shoulder was recognized but he does not recall that any attempt was made to reduce it. The arm was bandaged in the Velpeau position for six or seven weeks. He then came to Philadelphia and a surgeon took the arm from this position and said that there was no dislocation. The probability is that the subluxation or relaxed joint was present from the time of the accident. An X-ray showed a cervical rib on this side which was removed.

My findings were as follows. The general picture presented by the brachial paralysis was very similar to that seen in Cases I, II, III, and V, which seem to be far the most common type. His greatest

power was shown in the hand and wrist and these seemed to be about normal, indicating that the muscles which move the hand, most of which come from and make up most of the forearm, were practically normal. Pronation and supination of the forearm could be made but their power was considerably below the normal. The action of the biceps is very weak, but that of the triceps is very good, almost normal. All the muscles in the shoulder region are very much atrophied and the upper end of the humerus is almost subcutaneous. Sensation is good throughout the whole limb, except about the shoulder, where it is much disturbed but not lost. The shoulder joint is flail, the humeral head falling about a half inch below the acromion. The doctor was so anxious to return to his home that he could not give the time for an electrical examination. I did not advise in this case the operation done on the others, because of the eight years which had passed since the causal injury. In the absence of an electrical examination, and in the presence of the profound atrophy and impaired sensation of the shoulder region, I think that the affected muscles must have undergone degeneration beyond ability to recover as in the preceding cases operated on. Probably, only an arthrodesis or the transplantation of a portion of the trapezius into the deltoid could improve conditions in this case.

Although the limb was swung flail at the shoulder and was very much crippled, it was far from being a useless one. The grip of the hand was about as good as on the normal side. In a severe forceps delivery, after placing the right forearm in a suitable position, he found the hand very serviceable. The profound paralysis is distinctly localized to the muscles surrounding the shoulder joint, and grows progressively less the further we go down the limb away from the shoulder, until we find practically if not the normal power at the wrist and hand. I think it doubtful that any injury of the brachial plexus could produce such a severe paralysis and atrophy in the shoulder region without affecting any of the numerous muscles which move the wrist and hand, and which include almost all the whole mass of muscles of the forearm.

CASE VIII.—In this case the shoulder condition and brachial paralysis were overshadowed by the fracture of the humerus, pain, general distress and breaking down, which continued until the fatal termination and for which I have no explanation. No opportunity was afforded afterward to observe the effect of the operation on the movement of the shoulder joint and power of the limb, so that the report of the case might be omitted so far as its influence on the subject under discussion is concerned. It suggests why the shoulder joint condition is sometimes overlooked at the time of the accident.

Woman, forty-six years old, looks as if she might be 60 years old. Weight a short time before the accident 140 lbs, now 99 lbs. My first examination December 8, 1913. Referred by Dr B A McDermott August 30, 1913, tripped and fell to the floor in her home and injured the right arm. Two days later went to a hospital where a double fracture of this arm was diagnosed, and arm bandaged in Velpeau position. After three weeks plaster cast applied with arm in same position. At the end of seven weeks the cast was removed and non-

union discovered. She complained of much pain and this was accounted for by the statement that a nerve had been caught between the fragments. She was then etherized and the arm "broke over again" and a Velpeau bandage applied. For the past two weeks the arm has been at her side in right angle flexion, being supported by a sling from the neck under the forearm from the elbow to the wrist. She still complains of much pain in the arm.

On examination I found an ununited fracture about the middle of the humerus. The head of the humerus was much below its normal level under the acromion and could be pushed upward somewhat by pressure under the elbow, but not to its normal level on account of the pain produced at the fracture and shoulder joint. The joint is not flail as usual in this condition, but the head is more movable than normal from direct pressure on it. There seems to be considerable inflammatory infiltration in and around the joint. Sensation is present throughout the whole limb, but is best in the hand. Can move the hand weakly, pronate and supinate the forearm weakly and has slight power of flexion and extension at the elbow. Has not enough power, however, to lift her hand from her lap. Arm movements cannot be made on account of pain but she seems to have a little power in it. Patient looks weak, pale and distressed. Complains of almost constant pain in the affected arm.

Operation December 18, 1913, at University Hospital. Incision along posterior margin of deltoid which was retracted upward and outward and the arm was rotated backward. Tendon of the infraspinatus divided and dissected backward from the capsule, which was divided parallel with and midway between the glenoid and humeral attachments. Abduction of the arm was difficult because of the axillary inflammation but this forced the humeral head to its normal level under the acromion. The edges of the capsule wound were overlapped by catgut mattress sutures. In passing the needle for one of these sutures, it was observed that the needle passed with some difficulty and was seen emerging from the cartilaginous covered portion of the humeral head. It had passed through the bone for the distance of about an inch and about a half inch below the cartilage. This indicated a profound disturbance of nutrition.

The wound was then extended downward on the outer side of the arm almost to the elbow, passing over the circumflex nerve above and below the musculospiral below. The latter was lifted from its bed and retracted backward as much as possible. The middle of the humeral shaft for about three inches was broken up into small fragments, and the bone appeared to be soft when handled with forceps. Because of the weak condition of the patient, the desire to avoid hemorrhage as much as possible, and the hope that they might aid in making union more rigid, these numerous small fragments were not removed. The rough edges of the two main fragments were sawed off and brought together, the small fragments being pushed aside. A long Lane plate reaching from the surgical neck to the external condyle was applied and fixed by screws. Capsule sutures then tied, infraspinatus sutured,

muscles brought together and skin wound closed without drainage. An attempt was made to dress the arm at right angles with the body, but the screws had a poor hold on the soft bone and it was, therefore, brought to the side and fixed in this position with a light plaster cast, the forearm being placed across the chest and pressure being made under the elbow to keep the humeral head as far up as possible. Primary healing took place except for a very small opening at the lower angle of the wound which drained a serous discharge. An X-ray taken five days after operation showed that the screws had given way and the fragments separated. A week later the screws were removed. During the next four weeks the cast was renewed three times in the effort to relieve her distressing pain but without success. Discharged January 25, 1914.

May 13, 1914. In office to-day. Complains of much pain in right arm and back. Since leaving the hospital has developed a persistent cough, expectorates a purulent sputum and sweats profusely at night. Died July 16, 1914.

CASE IX —Man, colored, 53 years old, laborer. Admitted to Philadelphia Hospital August 3, 1914. About the latter part of the preceding June, he was compelled to give up his work on account of the pain in the left shoulder and helplessness of the left arm. He does not recall any severe injury to the shoulder or arm, although he thought his trouble began with and was due to a heavy strain of this arm and shoulder from shovelling stones while engaged in "concrete" work. He seems to recall the particular time at which it occurred, and referred to a particular shovelful and the way he threw it over his head. His statements, however, appear to be unreliable. He says that soon after this incident, or about the third of July, he sought relief at a hospital dispensary, where his condition was diagnosed as rheumatism, for which he was given medicine. He continued treatment there for about a month and on finding that he was not getting better and was unable to work, he came to the Philadelphia Hospital. On examination I found slight atrophy of the whole limb, most marked in the arm. The shoulder was tender on pressure and the pain was much aggravated on passive movement which was about fifteen degrees and passive abduction was not much better. The movements of the hand, wrist and elbow are not mechanically restricted, but it is difficult to determine how much power he has. Except for some weakness, the hand and wrist are normal, but the limb as a whole is almost useless. He says that it has improved a good deal since the beginning of the trouble. The head of the humerus has fallen about three-quarters of an inch below the acromion as shown by the X-ray and palpation. Efforts to push the head up to its normal level are only slightly successful and cause much pain. Because of the resemblance of these symptoms to those which preceded operation in Case II, it was suspected that the joint would be found filled by a similar material.

Operation August 13, 1914. Because the patient objected to taking ether, he was given hyoscine gr 1/50 and morphine gr 1/2, divided into three doses. An attempt was also made to anæsthetize the brachial

plexus by the Kulenkampf method, and the skin in the line of the incision was injected with the same novocaine solution (2 per cent) He was then turned on his right side and an incision made in the line of the deltoid fibres from the posterior edge of the acromion about four inches downward, care being observed to avoid the circumflex nerve After going through the deltoid the infraspinatus was exposed and divided in the line of its fibres, *i e*, almost at right angles with those of the deltoid This exposed the posterior part of the capsule, but only a small part of it with the widest possible separation of the infraspinatus wound By strong traction on the margins of the wound, however, and rotating the humerus, first in one direction and then the other, the capsule could be freed a considerable distance above and below with the aid of the finger and a blunt pair of scissors closed There was much less hemorrhage than usual The joint was opened by the usual capsule incision, parallel with the glenoid and humeral attachments, which was extended upward and downward with the scissors aided by the guidance of the finger where the capsule could not be seen Particular care is necessary to avoid cutting the circumflex nerve in the lower part of the wound and the long tendon of the biceps above which can be felt free in the upper anterior part of the joint Before the joint was opened the capsule was observed to be under tension and as soon as the capsule was divided, a considerable quantity of a grumous, jelly-like substance escaped Much of it had to be removed by the fingers The small visible portion of the cartilage of the humerus was normal to sight and this as well as all the cartilage of the humerus and glenoid that could be felt had a normal feel, indicating that the jelly-like substance was not the result of an infection It has always been difficult to introduce the capsule sutures and it was especially so in this case so that they were not used The arm was abducted to just beyond a right angle, which forced the head up to its normal level by tension on the axillary portion of capsule No sutures were necessary in the infraspinatus wound Catgut for the deltoid incision Silkworm gut for the skin Small rubber drainage tube to the capsule Dressing Right angle splint and light plaster cast fixed arm in this position and nearly full abduction Drainage tube removed in 48 hours, skin sutures in ten days and cast and splint in four weeks Whole limb completely paralyzed, then, except for slight movements in fingers September 29, 1914, gradual improvement in movement and power of hand and forearm Shoulder still stiff and painful

Persistent efforts were made to induce this patient to use forceful exercises to overcome the stiffness from the original injury and the operation, but he would have none of it Once he paid a visit to the surgical dispensary of the University Hospital where he could have the services of a masseuse, but he complained of the pain and would go no more I did not see him again until February 13, 1916, when he appeared to have full power and development of all the muscles of the affected limb, although he could abduct the arm only to the level of the shoulder and had corresponding limitation of external rotation. He was earning his living as a laborer.

CASE X —Man, printer, 42 years old Admitted to the Philadelphia



Hospital July 17, 1914, on the service of Dr H R Loux, with a fracture of the lower end of the radius, comminuted fracture of the surgical neck and upper third of the humerus and subluxation of the shoulder joint on the left side. About one week before he had fallen down a flight of stairs, injuring his left forearm, arm and shoulder. When union had been obtained in the fractured humerus and radius, Dr Loux kindly turned the case over to me for treatment of the shoulder condition. The whole limb was then very weak but had most power in the hand and wrist as usual, the power at the shoulder being practically nil. As my service ended October 1 at the Philadelphia Hospital, I had the patient transferred to the University Hospital and operated on the shoulder October 15, 1914. Incision along posterior margin of the deltoid. Fibres of the infraspinatus separated as in last case, exposing the capsule. Edges of the wound retracted as far as possible, and by rotating the humerus as far as possible, first in one direction and then in the other, the capsule was freed from the overlying muscle well upward and downward. Capsule divided as in preceding cases, and, as more room was available than in the last case, three mattress catgut sutures were employed to overlap the capsule margins, while the arm was held in abduction to about a right angle and external rotation. No abnormality was detected in the joint in this case. Very small drainage tube to the infraspinatus. Catgut suture of the skin wound. Dressing. Light plaster cast with arm at right angle abduction and nearly full external rotation. Drainage tube left in five days. Primary healing. Cast removed November 5, 1914, the patient remaining in bed to allow the arm to come to the side gradually, which it did in four days. As usual, the humeral head was now held firmly up under the acromion but the shoulder region was painful and tender because of the tension on the shortened structures. Massage daily. Left the hospital November 13. February 8, 1915, in my office. Abducts arm easily and quickly to angle of 160 degrees and has almost normal external rotation. There still remains slight mechanical restriction of shoulder movement which he promises to work out by more vigorous exercises. The power of the whole limb is practically normal.

CASE XI —Married woman, Italian, 21 years old, admitted to the Philadelphia Hospital August 21, 1915. About a month before admission, she woke one morning to find that she was not able to lift her left arm from her side. She says that she could move her fingers but they were very weak. She could not move her forearm except by picking it up with the other hand. The day before she had been working hard cleaning her two rooms, and this included the moving of her furniture, the heaviest of which was a brass bed. When she went to bed the night before she had not noticed any trouble with the left arm. On the following morning when the arm was paralyzed, the shoulder and arm were very painful and the muscles very tender. She has not noticed any ecchymosis at any time. About two days after the beginning of the trouble, she went to a doctor who told her the condition was due to a cold. A man, who has been a hospital attendant at the Philadelphia Hospital for, at least, thirteen years, and is unusu-

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ally reliable, saw her within a week after the beginning of the trouble and he says that her shoulder and arm at that time were "swollen and red" The redness suggested inflammation to him but evidently was not of the infectious variety At the time of admission, the power of the hand and forearm was good but below normal She could abduct the arm from the side only about 20 degrees, while passive abduction was almost but not quite normal and caused considerable pain She left the hospital September 3, 1915 About a week before Dr J W McConnell made an electrical examination with the following results

Galvanic current, Right deltoid, with the cathode, shows normal response, good volume, to 35 cells

On left side, same position, gives no response Biceps on right side, normal On left shows good prompt response but not quite as good as on right Triceps on right normal, on left not obtained Supraspinatus on right normal On left normal Over left deltoid there is no response to anode or cathode, using a current strength which gives a very positive reaction on the right side Same is true of the triceps on the left side An area of hypalgesia on the left side, commencing about an inch above the tip of the acromion process, about an inch and a half broad tapering extending down over the shoulder  $2\frac{1}{2}$  to 3 inches Otherwise the sensation of the arm is normal

The power of the arm at the shoulder showed marked improvement every day until when she was leaving the hospital she could raise it straight up alongside her head She could raise an ordinary kitchen chair with the right or normal arm, but could not raise it from the floor with the left arm

Two days after the patient left the hospital, Dr McConnell made the following examination at his office

Faradic current Right side, Deltoid, ant mot point, normal response Post mot point, normal response Pect maj, mot point, normal response Trapez, mot point, normal response Infrsp, mot point, normal response

Left side Same current and strength, Deltoid, ant mot point, much less than normal response Post mot point, slightly less than normal response Prot maj, mot point, much less than normal response Trapez, mot point, normal response Infrasp, mot point, much less than normal response In all these tests the current strength was equivalent to four sections of a Fleming coil, the iron core being entirely covered

Galvanic current Dry cell battery, forty-five cells

Right side Normal response at all motor points previously examined by faradic current

Left side Deltoid, post mot point, normal response, *i e*, identical with response obtained on right side Ant mot point, with cathode as active pole, application is not followed by immediate response Quite some time is required to overcome the resistance The response at first small, increases in volume until a very violent muscular action is obtained This action, however, is not limited to the muscle under examination, but is diffused to other muscles constituting the shoulder

group, with the anode, some time is required to overcome resistance and the response is fairly large, but is confined to the portion of muscle under the electrode and there is not the same sharp contraction which is obtained on the normal side. The same is true as to the other points examined which were found by the faradic current to differ from the normal side. Dr McConnell's conclusions. This patient has had a neuritis from which she is recovering. The peculiar response which is obtained is due to the subsidence of the neuritis and the restoration of electrical conductivity. That this has not been fully restored is evidenced by the qualitative change to galvanism, serial and modal.

Patient examined at Philadelphia Hospital March 4, 1916. Left arm has recovered much of its normal power, so that it can be used very well in doing her housework. There is, however, a small distinct difference in power of the two limbs. This difference is more distinctly manifested by the rapidity with which the left arm tires and that shoulder begins to ache, when the arm is used. The patient finds herself unconsciously using the right arm to save exhaustion and pain. When lifting a weight with the left hand she is conscious of a peculiar giving way or dropping of something in the shoulder of that side.

Patient seen again at Philadelphia Hospital May 5, 1917. The mild relaxation of the left shoulder joint still persists (see Fig 4) although the power of the shoulder muscles has improved slightly but distinctly since the last examination. The patient uses this arm in all her work without special difficulty, except that it tires easily, is weaker than the right and after being used for a time begins to ache. An effort was made to determine the difference in strength of the two arms. The testing could not be applied directly to the shoulder muscles, but special apparatus in the gymnasium of the University of Pennsylvania was employed. The following results were obtained. Grip of both hands was the same. Pulling by grip of hand with arm held forward level with shoulder and counter-support against front of chest (flexors). Right side 45 kilograms and left 30 kilograms. Arms at same level and back supported, pushing object away by hands (extensors). Right 52 kilograms and left 50 kilograms. Lifting by hands in standing position. Right 145 kilograms, and left 125 kilograms. When hanging by the right hand she readily suspended her whole weight, but when using the left hand could not take her feet from the floor because of weakness in that arm and some pain at the shoulder. A number of dumb-bells were tied together by a piece of rope, a loop at the other end for the hand and long enough to reach above the level of her shoulder. The whole weight was 36 pounds. On the first trial she lifted this weight from the floor with the right hand and held it for 12 seconds, and with the left hand for six seconds. After several other trials without timing, a second test showed that she held up this weight with the right hand 24 seconds, and with the left one second. In other words she barely lifted the weight from the floor for a moment with the left hand. She said the left shoulder felt exhausted and was aching and had the sensation of giving way when she tried to lift.

## TRAUMATIC BRACHIAL PARALYSIS

It will be recalled that the history does not show a traumatic origin in this case. I have assumed that it was traumatic as I believe the origin was traumatic in case IX, and as it evidently was, although very slight, in case II. One would hardly expect as severe a condition from the degree of trauma in cases I and III, yet there can be no doubt of a traumatic origin in these two. A mild original injury agrees with the mildly flail joint, slight dropping of the humeral head shown by the X-ray, and mild permanent impairment of function of the shoulder muscles, in this case. The skiagraphs in Fig 4 indicate that the mildly flail shoulder joint is probably permanent and that the patient will never recover perfect function in it.

CASE XII—Colored man, 58 years old, laborer. Admitted from the neurological dispensary to the surgical service of Dr C H Frazier in the University Hospital January 17, 1916. The following history was taken by the interne, Dr W Frank. Five weeks before, he was thrown from a wagon striking on his left arm, shoulder and head. He was unconscious for five or ten minutes. Since that time he has not been able to raise the left arm from his side nor flex his elbow. Otherwise he was perfectly well. He can move the arm only by swinging it from the shoulder. The acromion on this, the left side, is more prominent than on the right. Extension at the elbow is about normal in extent and power. The power of abduction is nil, but adduction is fairly good, almost as good as on the right side. Internal rotation is normal, but external rotation is slight. There is marked atrophy of the deltoid, supra- and infraspinatus and trapezius of that side. There is no weakness in the elevation of the left shoulder girdle. Left deltoid jerk is present but diminished as compared with the right. Left biceps jerk is present but very weak. Left triceps jerk is normal. No weakness of muscles of left forearm. Sensation is normal over the left shoulder region, chest, back and left arm. January 20th, the muscles and nerve reactions were tested to-day. No reactions of degeneration were found.

The following examinations were made in the neurological dispensary, January 3, 1916. "Complete paralysis of left deltoid, triceps, brachialis anticus, supraspinatus, infraspinatus. No disturbance of sensation. Triceps and muscles of forearm and hand good. No faradic response over following muscles in left arm: Biceps, deltoid, triceps (?), supinator longus. Slow response over extensors. Slower response of flexors of fingers on left as compared to the right." Second Examination, January 5, 1916. "No faradic response over supraspinatus and infraspinatus, biceps and deltoid. Good response over triceps, flexors and extensors, though slower than on right side." Third examination, January 20, 1916. Faradic response in deltoid and in biceps on left side obtained with current stronger than is used on right side, but the response is very prompt. Other muscles of arm and forearm respond in normal manner.

Operation January 25. Incision along posterior margin of deltoid. Infraspinatus muscles lifted from capsule which was further exposed upward and downward under the teres minor. Usual incision in capsule. Finger in joint failed to locate the long tendon of the biceps.

which is usually found easily. Second incision along anterior margin of pectoralis major and capsule opened over the bicipital groove. The long tendon of the biceps which normally occupies this groove, could not be found as it had torn from its attachment to the upper glenoid margin and had retracted downward from view. The greater tuberosity was unduly prominent and the bicipital groove obscured from a previous fracture. No sutures in capsule wound. Continuous No. 1 iodine catgut suture for anterior and posterior skin wounds. Small rubber drainage tube in lower angle of posterior wound for uncontrollable oozing. Dressing and bandage. Arm fixed by light plaster cast at an angle of about 130 degrees and nearly full external rotation (see Fig. 7). January 27, hole cut in cast and drainage tube removed. February 6, primary healing and patient sent home with arm in cast. Returned to hospital February 20 and on following day cast removed. Patient remained in bed for next four days to allow arm to work down to side slowly. There was then moderate swelling from the shoulder to the fingers. The whole limb was much weaker than before the operation. The triceps which was normal before operation now shows little or no power.

The return of power was unusually slow in this case. I did not see him again until April 18, 1916, when he could use the hand very well but in the standing position could not flex the elbow in the slightest degree. He could abduct the arm from the side about 20 degrees. In the recumbent position he could abduct it about 60 degrees and lift the whole limb forward from the shoulder. With the arm elevated a little he could flex the elbow weakly and carry the hand to his mouth. There was still a marked limitation of movement at the shoulder. It is evident that he has failed, almost entirely, to force the movements of the shoulder because of the pain involved. June 8, 1916, there was a marked improvement in the power of all the muscles but in the upright position he still was unable to make any flexion at the elbow. In the recumbent position he could carry his hand to his mouth rapidly. August 6, 1916, there was a decided improvement in power throughout the whole limb, but there is little or no improvement in motion at the shoulder and a decided crepitation is developed on passive movements of it. In the standing position he can flex the elbow and carry his hand to his mouth and top of his head easily. He can support his whole weight by the grasp of the hand of the affected arm. Examination October 16, 1916, by Dr. W. B. Cadwaladar, in the neurological dispensary of the University Hospital: "To-day all the muscles of the left shoulder girdle contract well and with considerable power but not quite so strongly as the corresponding muscles of the right side. It seems as if the only disability was entirely due to arthritis or adhesions about the shoulder joint. There are no changes of sensation for light touch, pain or temperature, i. e. sensation is normal. All movements, flexion, rotation, supination, abduction and adduction, can be well performed, except for limitation in the joint. There is positively good contraction of the left deltoid, biceps, brachialis anticus, supra-

## TRAUMATIC BRACHIAL PARALYSIS

spinatus, triceps and infraspinatus There is possibly less power in the infraspinatus proportionately than in the other muscles" While the return of power has been slow in this case, it has never ceased to progress and is as rapid now as at any time

April 29, 1917, the patient reports that he has been at work as a laborer for a few months, working every day and doing a full day's work, earning fifteen dollars a week, an unusual amount for him He seems to have full power in most of his muscles, but still can not elevate the arm above his head because of the limitation of movement in the shoulder He was readmitted to the University Hospital February 26, 1917, for the removal of a keloid growth on the back of the right shoulder, and while under ether the left shoulder was manipulated as strongly as was felt to be safe in an effort to restore some of the restricted movement This did not seem to be successful, but an opportunity was afforded while he was in the hospital to drill into him the kind of exercises that were necessary to restore motion He is now able, after going through some preliminary exercises, to hold the arm up in the air for a short time by bending his shoulders backward (see Fig 9) For six months after operation he probably made little or no effort to exercise the shoulder and until his last visit to the hospital showed marked indifference

CASE XIII —Man, 52 years old, referred by Dr J Binder About a week before Easter of 1916, while fixing an awning, he fell from a ladder from the level of the second story, injuring his left shoulder It appears that there was a dislocation at the time which was reduced at a hospital on the following day The arm was dressed in the Velpeau position and the patient discharged the same day to return to the dispensary daily The bandages were removed in three weeks and massage and passive movements given for six weeks more Immediately after the accident the whole limb became helpless and was very painful

Examination June 20, 1916, about twelve weeks after the accident Sensation is good throughout the whole limb He can abduct the elbow from the side about four or five inches, and elevate it forward to about 45 degrees Posterior elevation is nil With his arm at his side he can flex the forearm to about an angle of about 45 degrees and can just touch the thumb to the mouth by bringing the mouth toward it as far as possible In the recumbent position with his arm at his side and the hand touching the floor, he can flex the forearm at the elbow only very slightly, *i e*, he can lift the hand only about 3 inches from the floor In this position he has practically no abduction Rotation of the forearm is only slightly limited in range but is very weak There is a considerable œdematous swelling of the hand and fingers which extends about halfway up to the forearm He has passive abduction at the shoulder to about 45 degrees There is a distinct dropping of the humeral head below the acromial process but by pressure under the elbow it can be forced up to its normal level only to drop again as soon as the pressure is removed

The following neurological examination was made by Mr Arnett, a fourth year medical student in the Neurological Dispensary of the Uni-

versity Hospital Although left-handed the patient's left arm is smaller than the right (measured at biceps, L 26 cm, R 27.5 cm) Left forearm 25 cm, right, 25.5 cm There appears to be some dropping of the shoulder and the head of the humerus appears to be lower than the right All movements can be performed with the left hand and forearm but they are very limited The fingers can be moved only 30 degrees, the wrist 35 degrees, the forearm about 50 degrees Heat, cold, touch and pain are normally perceived in the left hand, forearm and arm The left hand, oedematous and shiny, measures 21 cm across the knuckles, while the right measures 19.5 cm The following electrical examination was made by Dr J W McConnell Right upper extremity shows no abnormality to either current, faradic or galvanic In the left upper extremity there is no response to faradism in the deltoid muscle All other muscles respond, but a slightly greater current strength is needed than is used on the right side To galvanism all muscles respond normally save the deltoid which shows both serial and modal changes

Operation was performed June 28, 1916, at the University Hospital Same incision through deltoid and infraspinatus as in case IX, and same incision in capsule With arm in full abduction and external rotation, the finger could be passed to the anterior part of the joint where the torn edge of the capsule could be felt and in it a fragment of bone torn from the anterior glenoid margin This is the common ligamentous lesion of a dislocation No sutures were introduced into the capsule The deltoid incision was closed with No 1 plain catgut Same for skin No drainage except between sutures Plaster cast with arm in full abduction and external rotation Primary healing Cast removed in two weeks on account of distress it caused Arm brought to right angle and fixed there by splint, which was removed a week later and the arm brought to the side There was already a considerable improvement in the movement of the elbow and hand but the swelling which had largely disappeared with the arm elevated reappeared after it had been let down On December 9, 1916, he could elevate the arm almost to the horizontal The elbow movements were normal and the hand movements much stronger although still considerably limited in their movements There is now very little swelling in the hands and fingers and above the wrist Because of the pain at the shoulder the forearm sling was used until three weeks ago April 25, 1917, all movements of the limb have improved very much Can almost close fist as on normal side and uses the hand and arm in his work very well There is a still slight swelling of hand and weakness of whole limb Can elevate arm forward to about 110 degrees actively, and after lifting it up straight above his head with the other hand can hold it there by tilting his shoulders backward slightly This is a recent accomplishment, but is an evidence of what has proven true of all the cases, *i e*, after the joint has been restored to its normal relations and firmness the improvement never seems to stop until the normal is reached or closely approached Restriction of movement is the only obstacle to a return of normal function

CASE XIV —Man, 65 years old Particularly dull and slow mentally and physically Admitted to the Philadelphia General Hospital, November 29, 1916, to the service of Dr H R Loux, who kindly turned the case over to my service Ten days before admission he fell on a slippery pavement and sustained an injury to the left shoulder, was taken to a station house and did not believe until the following day that his left arm was hanging helpless at his side He says that he went to a hospital the same day and had a dislocation of this shoulder reduced On admission his hand was practically useless he could not abduct the arm from the side and had only very slight power of flexion at the elbow He had a little movement in the fingers Passive movement at all the joints is painful and probably accounts for some of the failure to move the different parts of the limb This applies particularly to the wrist drop which is present, as passive extension beyond the straight position in this joint is very slight because of the stiffness and pain There is a distinct hollow to palpation under the acromion and consequent flail joint This could not be shown by the X-ray because on repeated trials he would, when the machine was started, obliterate the interval between the acromion and upper end of the humerus by unconsciously contracting his shoulder muscles There are areas of disturbed sensation especially in the hand There is a tinge of cyanosis and slight swelling in the hand and the fingers can not be fully flexed, while efforts to force them cause pain

Electrical examination by Dr S Leopold at the University Hospital:

No response to the galvanic current in the biceps or other muscles of the left arm, but with strong faradic current reactions were elicited in the biceps, long head of triceps and in the deltoid These reactions were weak in all three muscles In the other muscles about the shoulder (supraspinatus, infraspinatus, pectoralis major) no response was obtained Considerable pain was complained of when the current was applied to the left shoulder region, while with the same current on the normal side there was no pain, showing, therefore, a very hyperæsthetic area about the injured shoulder No reactions were elicited in the extensors of the forearm

This case seemed to offer the opportunity of trying out an idea which had suggested itself some time ago If, as I believe, these flail shoulder cases are ordinary anterior dislocations in which the hyperabduction has been extreme enough to tear the capsule from the humeral attachment all around, with consequent dropping of the humerus until other surrounding structures take up the support, it would hardly be good surgery to fix the arm in abduction at the time of the accident This would force the humeral head into the dislocated position and keep it there But three weeks had elapsed in this case, so that sufficient healing had occurred in the axilla to prevent dislocation when the arm was forced into full abduction Enough tearing of the cicatricial axillary tissue would probably occur to cause considerable joint inflammation and shortening of the upper part of the capsule if it were kept relaxed by abduction and external rotation long enough On



December 12, 1916, under ether, the arm was forced into full abduction and external rotation with evident tearing of tissues in the axilla, and kept in this position by a plaster cast. This was removed January 30, 1917, six weeks later and patient kept in bed about a week later while the arm was gradually coming down to the side of the body. He was let out of bed a few days later with the forearm in a sling which was soon discarded. He was encouraged to force the arm back into the fully abducted and externally rotated position as often as possible. He did this fairly well and had almost all of these movements passively when he was sent to the City Home for the Indigent, February 15, 1917, but he had gained only slightly in power. He was readmitted to the hospital with croupous pneumonia March 15, 1917, and died of this condition five days later. The shoulder joint was still firm and not in the least flail when he was discharged from the hospital and probably did not become relaxed later.

*Conclusion*—The effort here has been to show not how the flail shoulder produces the permanent paralysis so much as to show that it does. The only worth-while proof offered is that early removal of the flail joint and restoration of normal motion in it, results in the disappearance of the paralysis. It hardly seems necessary to argue that if the paralysis and flail shoulder had been caused by a rupture of the brachial plexus, recovery would not have followed, uniformly, treatment restricted to the shoulder joint. According to my experience, in most cases of traumatic brachial paralysis the shoulder joint is not in the least flail, but on the contrary exhibits limited movement and pain when movement is made. Is it not fair to ask those who account for these cases by an injury of the brachial plexus, to explain why the flail shoulder is found in only a few? The following observation made during the past six years seems worthy of some attention. I have read almost every paper on obstetrical paralysis published within recent years and many old ones, and have constantly been on the lookout for the report of an obstetrical palsy with flail shoulder but as yet without success. I found twice a vague reference to the condition but without any reference to a case. In view of the large number of cases of obstetrical palsy reported, hundreds of them in recent years, I am inclined to doubt its occurrence. If it does not occur it then becomes necessary for those who account for the obstetrical paralyses by an injury of the brachial plexus to explain the absence of flail shoulder in this class of cases.

## MYXOFIBROMATA OF THE ABDOMINAL WALL

By K S J HOHLEN, M D

OF LINCOLN, NEBR

MYXOFIBROMATA of the abdominal wall are not uncommon. They occur most frequently in women, especially during the childbearing age. The etiological factor in women is in the largest per cent of cases due to rupture of the posterior sheath of the rectus muscle during labor. Other traumas may produce the same condition, especially in men. These tumors usually are the size of a hazel-nut or walnut. Occasionally they grow to an enormous size and have been reported as large as a child's head. They are firm, hard, generally round or spherical tumors and seem to follow the muscle fibres and tendon sheath of the muscle affected. The recti muscles are the ones usually affected. It is very rare that the oblique muscles are involved. The right rectus is most frequently the site for such a growth. They usually grow outward but occasionally inward. They are usually single in number.

The diagnosis is generally easy, especially where the tumor mass is small. A differential diagnosis will have to be made from lipoma, hæmatoma or abscess. Where the tumor attains a large size, especially where the growth is inward into the abdominal cavity, the diagnosis may be difficult. These larger tumors will have to be differentiated from intra-abdominal conditions such as ovarian cyst, nephroma, enlarged spleen, floating kidney, fibroid attached by pedicle to uterus, etc.

The treatment is surgical by radical excision. Where these tumors reach a large size it is sometimes necessary to do an extensive resection to close the opening left. These tumors are generally benign tumors. It seems to be evident that these individuals are predisposed to an over-development of connective tissue. Balfour, of the Mayo Clinic, reports seven cases in the *Railway Surgical Journal*, and in two of these the tumor occurred in previous operation scars.

CASE No 273—A young woman twenty-four years of age presented herself for examination. She complained of having a tumor which had been getting gradually larger since her first child was born five years ago. She stated that one doctor had informed her that she had a tumor of the ovary. She said that the tumor was getting so large that it interfered with her work. It was also beginning to be painful.

Personal history was negative. Menstruation began at eleven. Was married at the age of seventeen. Had two children, both living. There had been no menstrual disturbance at any time. Physical examination showed a tall robust young woman. Heart and lungs negative. A large tumor occupied the entire left side of abdomen. This tumor seemed to be in the abdominal cavity because of the growth inward.

Uterus and appendages were normal upon examination. Urine and blood examinations were negative. At first it was rather difficult to make a diagnosis because the tumor seemed to be intra-abdominal.

February 16, 1917, at St. Elizabeth's Hospital under ether anesthesia, the tumor was excised, and with it was included the entire left rectus muscle with the fascia and peritoneum covering it. This left a large opening which had to be closed. This was accomplished by resection of the various abdominal layers and closing the same as in any hernia of the abdominal wall. The recovery was uneventful excepting a persistent drainage for several weeks (probably due to fat necrosis or oozing), which finally healed with a good serviceable abdominal wall. The tumor (Fig 1) weighed twenty-two ounces.

The pathological report from Dr. George Covey is as follows:

Grossly the tissue appears somewhat gelatinous, yet firm to the touch. Microscopically, the fragment taken from the ventral portion of the tumor shows a typical myxofibroma (Fig 2). The fibrous tissue is in excess of the myxomatous and spider cells are seen only in small isolated areas. There are no remnants of muscle tissue.

The portion from the dorsal aspect of the tumor contains one fair sized bundle of muscle fibres. They are, however, undergoing degeneration, as shown by shrunken nuclei and fragmenting and granular cytoplasm. At the edges of the bundle there is replacement of the muscle by fibrous tissue (Fig 3) and in the surrounding tumor mass are isolated fragments of degenerating muscle cells.

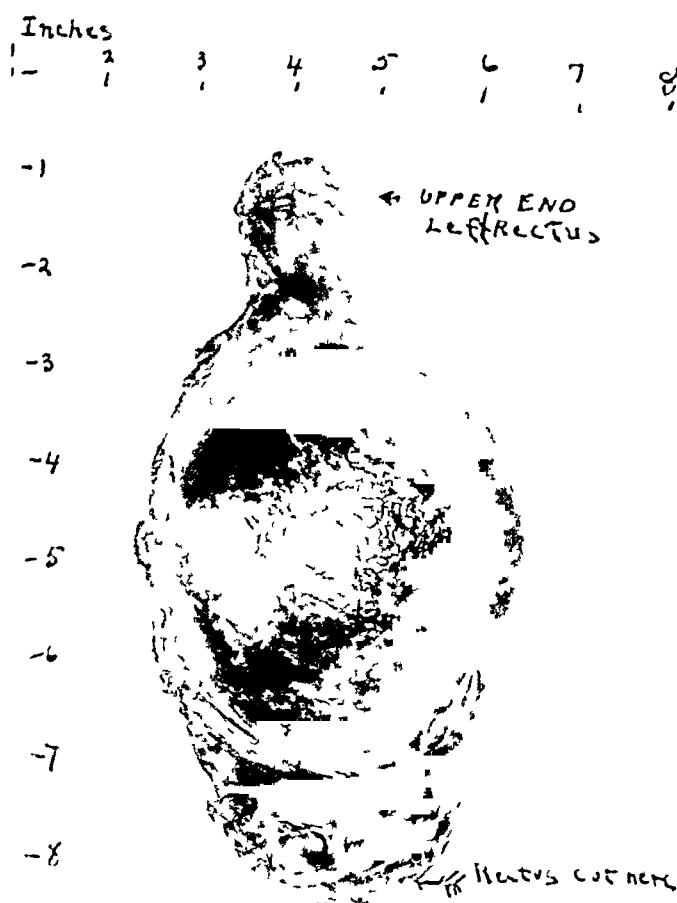


FIG 1 —Fibroma of rectus, peritoneal surface



FIG 2 —High-power photomicrograph of the myofibromatous tumor mass replacing the right rectus muscle



FIG 3 —Photomicrograph of remnant of muscle (rectus) along the dorsal side of tumor. This area is surrounded by the myofibromatous tumor mass



# GALL-STONES IN INFANCY AND CHILDHOOD

BY DANIEL N EISENDRATH, M D.

OF CHICAGO, ILL

So few cases of cholecystitis with or without calculi occurring below the age of twenty have been published that it may be of interest to report the following two cases, both in girls of fifteen

CASE I—Girl of fifteen admitted to my service at the Michael Reese Hospital on May 19, 1914 Her illness had begun one year before with pain in the right hypochondrium, which radiated toward the left and around to the right shoulder The first attack lasted ten hours, during which time she vomited once During the year preceding her admission there had been a number of similar attacks, during several of which jaundice of a slight but distinctly noticeable degree had been present The attack on account of which she had been sent to the hospital had begun suddenly four days before with severe colicky pain in the right upper quadrant of the abdomen, radiating in a backward direction and towards the left She had vomited at frequent intervals during the three days before admission There had been no jaundice present during this attack There had been no history of typhoid, the patient having lived in the Home for Orphans for a number of years under the careful observation of Dr May Michael who sent her to the hospital The abdomen when first examined by the writer was markedly rigid and tender in the right upper quadrant The white blood count was 20,000, 87 per cent of which were polymorphonuclears Rectal temperature 101.2° F A diagnosis of acute cholecystitis was made and operation advised on account of the frequency of the attacks during the year preceding her admission

Under anæsthesia one could palpate an ovoid mass extending about two inches downward from the right costal margin, which was considered to be a greatly distended gall-bladder This was confirmed when upon opening the abdomen, a gall-bladder about the size of a lemon was found tensely filled with fluid and with omentum lightly adherent to it The serosa was intensely red and œdematous as far down as the common duct There was an acutely enlarged lymph-node at the neck of the gall-bladder and the walls of the organ were very thick The common duct was found small and negative to palpation Upon opening the gall-bladder a large amount of thin purulent fluid under great tension and a number of faceted cholesterol calculi escaped About fifty of these were removed, four of which were found in the greatly dilated cystic duct

Cholecystectomy was done on account of the evidences of advanced chronic inflammatory changes in the walls and the danger of recurrence of calculi. The examination of the gall-bladder after removal revealed numerous hemorrhagic and gangrenous areas in the mucosa. The cystic duct, although much dilated, did not show these changes. The walls were greatly thickened and œdematous throughout. Patient made uneventful recovery. This case is of interest because of the acute infection supervening upon a chronic cholecystitis with calculi in a girl of fifteen, whose history of recurrent attacks dated back over a year.

CASE II—Girl of fifteen admitted to my service at the Michael Reese Hospital on July 7, 1916, suffering from severe pains in the right upper quadrant of the abdomen which had begun about eighteen hours before. Vomiting at frequent intervals accompanied the pain. She gave the history of having had six similar attacks lasting from ten to sixteen hours during the year preceding the present attack. There was no history of typhoid. Examination of the abdomen showed marked tenderness and rigidity over the right iliac region and a tense, tender mass like a distended gall-bladder in the right hypochondrium. The white blood count was 20,800, rectal temperature 100.5° F.

The diagnosis rested between acute appendicitis and acute cholecystitis, or the simultaneous presence of both conditions. The age of the patient (fifteen years) would have made me hesitate to make a diagnosis of cholecystitis with or without calculi, had it not been for the fact that the mass to be felt in the upper abdomen was quite distinct from the rigidity and tenderness of the right iliac region. A right rectus incision was made so as to be able to examine both the appendix and gall-bladder. The latter was found to be the size of a large pear very greatly distended, with marked œdema of the tissues around the neck of the gall-bladder. When the viscus was opened a large quantity of mucoid fluid escaped as if under great tension. Ten cholesterol, pea-sized calculi were found, one of which had completely blocked the cystic duct and caused an "acute hydrops" of the gall-bladder. On account of the danger of recurrence of infection, the gall-bladder was removed. Its walls were very œdematous and the mucosa showed a diffuse redness due to many hemorrhagic areas.

The appendix was removed and upon opening it a stricture was found at its middle with much clear mucus under tension and thickening of the walls distal to the narrowing. There were a number of punctate hemorrhages in the mucosa of the outer half of the appendix and roughening and injection of the serosa.

The patient made an uneventful recovery. The two most interesting features of this case are the age of the patient and the concomitant presence of an acute cholecystitis with many calculi and of an acute exacerbation of a chronic appendicitis.

## GALL-STONES IN INFANCY AND CHILDHOOD

Up to 1913 Khautz<sup>1</sup> was only able to find the reports of 15 cases. Of these 5 were autopsy observations, one case was in a new-born infant and in only 9 cases was the diagnosis confirmed by operation.

The symptoms did not differ from those in adults. All of the patients above the age of thirteen were girls. In 4 of the 9 cases which were operated, calculi were found up to 20 in number.

Wharton<sup>2</sup> found an acute empyema of the gall-bladder in a girl of fifteen, three weeks after an operation for acute appendicitis, showing the concomitant presence of infection in the gall-bladder and appendix as in my second case. Only one case<sup>3</sup> has been reported since the article by Khautz, making a total of thirteen cases, including the above two of my own in which the diagnosis was confirmed at operation.

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<sup>1</sup> Zentr f d Grenz g d Med, 16, 546, 1913

<sup>2</sup> Trans Am Surg Assn, 1909

<sup>3</sup> Semaine Med, 22, 790, 1913



## NOTES ON FOUR KINDS OF APPENDICITIS \*

By ROBERT TUTTLE MORRIS, M D.

OF NEW YORK

*Appendicitis Irritans*—The commonest form of appendicitis appears to represent an irritative lesion and not an infective lesion. It was named "appendicitis obliterans" by Senn, whose contribution to the subject appeared in *The Journal of the American Medical Association* in 1894. Senn believed this condition to depend upon a relapsing infection of mild degree, followed by tissue changes resulting in final disappearance of normal structures of the appendix. He held that the condition called for prompt operation.

In the previous year, Ribbert (*Virchow's Archiv*, 1893) had described the same condition in a different way. He believed it to represent an involutional process that was not pathological. In advance of Ribbert and of Senn, Fitz, in 1886, refers to obliteration of the appendix as a result of previous inflammatory processes.

Disagreement on the part of these three early writers led me to make an independent study of the subject, and my own conclusion included the idea that in cases of appendicitis obliterans we were dealing with a normal involution process belonging to a vestigial structure. The subject appeared to belong to ontogeny rather than to pathology fundamentally. The pathology of obliterating appendicitis seemed to be incidental to the presence of nerve elements persisting in the midst of hyperplastic connective tissue which was undergoing contraction. Irritation of the fibroid appendix nerve elements is not very different from irritation of nerve elements in any sort of scar tissue. A local leucocytosis occurs, local discomfort follows, sympathetic nerve ganglia become excited and excitation of sympathetic nerve ganglia leads to afferent and efferent response by way of the spinal cord centre. Disturbance of the innervation of the entire gastro-intestinal tract may then follow in certain susceptible patients.

Early involution of the appendix seems to occur most frequently in patients who show other stigmata of physical decline, such as narrow costal angles, crowded teeth, gunstock scapulæ, or a defective helix of the ear. Such patients belong commonly to the neurasthenic group with relaxed peritoneal supports. For that reason an irritative appendix has led many a surgeon into the trap of believing that removal of the appendix in such a case would dispose of other symptoms belonging to the general condition of a neurasthenic patient. Personally, I have not escaped the trap. An advanced degree of involution of the appendix does not belong to the very young but the process may be

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\* Read before the New York Surgical Society, May 9, 1917

## FOUR KINDS OF APPENDICITIS

found under way in perhaps one-third of all appendices in people twenty years of age Ribbert found that more than fifty per cent of all appendices were obliterated in people past the age of sixty years

In specimens which I examined obliteration appeared to begin most frequently at the distal extremity of the appendix and to consist in gradual replacement of all structures of the appendix by hyperplastic connective tissue The mesentery of the appendix took part in the involution process with final disappearance of its structures In advanced cases the appendix consisted of little more than a fibrous string, resting behind flattened peritoneum

It is my belief that the presence of abundant new cells in appendices undergoing involution obliteration is due to irritation of nerve elements by contracting connective tissue, rather than to the presence of bacteria or their toxins It is my feeling that an appendix undergoing the process of fibroid degeneration (involution obliteration) is particularly safe against infective invasion, and for two chief reasons

The first reason includes the idea that structures which would be injured in the course of bacterial invasion are gradually disappearing from the appendix which is yearly becoming more and more fibrous

In the second place the irritative feature calls out a local hyperleucocytosis which is more or less protective against bacterial assault upon appendix tissues For this reason I have sometimes referred to irritative appendicitis as "protective appendicitis" when making contribution to the literature of the subject The patient appears to be protected against the dangers of acute infective processes at least

It is a fact that a low grade inflammatory process with many bacteria present involves the mucosa in some cases of irritative appendicitis Whether the obliteration process is hastened by this inflammatory feature or whether the inflammatory process is incidental to lack of resistance on the part of structures undergoing involution I cannot say. The definitely determined fact that abundant new cells are found in appendices which for years have lost their mucosa and other normal structures altogether would seem to offer ground for my belief in the irritative character of the lesion as opposed to the idea of an infective feature playing chief causative part

Fig 1 represents a cross-section from a case of irritative appendicitis in which the mucosa has become entirely replaced by connective tissue The lumen is obliterated, but round-cells are to be observed in the centre of the mass

The chief symptoms of irritative appendicitis are the chief symptoms of any form of chronic appendicitis and different from the chief symptoms of any form of acute appendicitis Placing symptoms in the order of their importance we have· (1) Hyperæsthesia of the right lumbar sympathetic ganglion, situated about one and one-half inches to the right of the navel and a trifle caudad, near the spinal column.

(2) Distention of the ascending colon with gas (3) Transitory pains in the appendix region, not important enough to send the patient to bed, but often sending him to the doctor's office

Concerning the first symptom Why should there be hypersensitivity of the right sympathetic lumbar ganglion, when there is no direct nerve connection between the appendix and this ganglion? I believe it to be due to an efferent impulse which goes out from the spinal cord centre by way of sensorimotor synapsis to this ganglion, as well as to the skin in the Head zone for the appendix An efferent impulse sent from the irritated appendix to the cord centre is thus manifested symptomatically in two ways by the efferent response

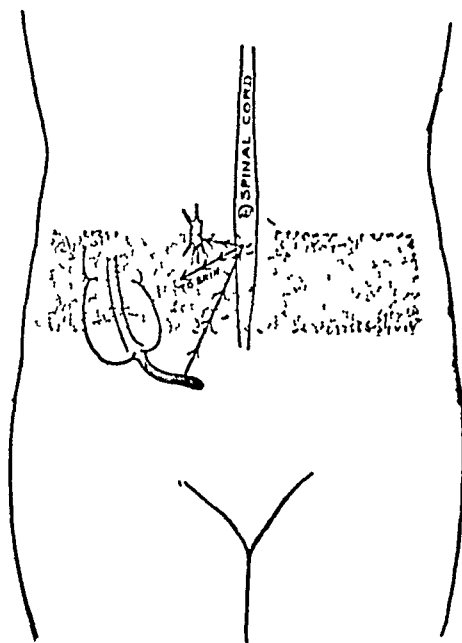


FIG 2 —Diagram to show lines of efferent impulse going out from the cord centre

Fig 2 is a schematic drawing indicating the way in which two lines of efferent impulse go out from the cord centre One nerve path leads to the skin in the Head zone for the appendix, the other nerve path leads to the right lumbar sympathetic ganglion Irritation of the right lumbar sympathetic ganglion does not end the history of disturbance referred along sympathetic nerve paths, but I shall stop at this point in the present paper in order to concentrate attention upon the diagnostic value of hyperæsthesia of the ganglion in question

Concerning the second diagnostic point Why should there be distention of the ascending colon with gas? We may postulate that the irritated appendix overstimulates the innervation of the ascending colon until the muscularis of this part of the colon becomes more or less exhausted from persistent nagging When in this exhausted condition the ascending colon is more or less flaccid and it readily becomes a receptacle for gas

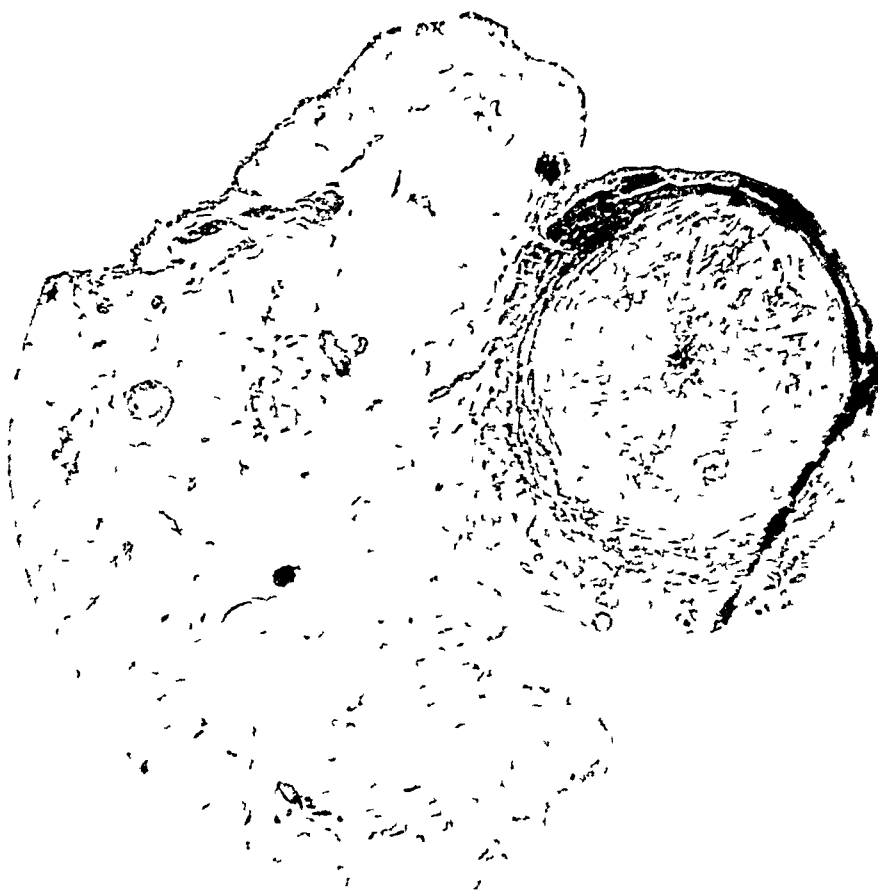


FIG 1—Irritative appendicitis Mucosa entirely replaced by connective tissue, lumen obliterated

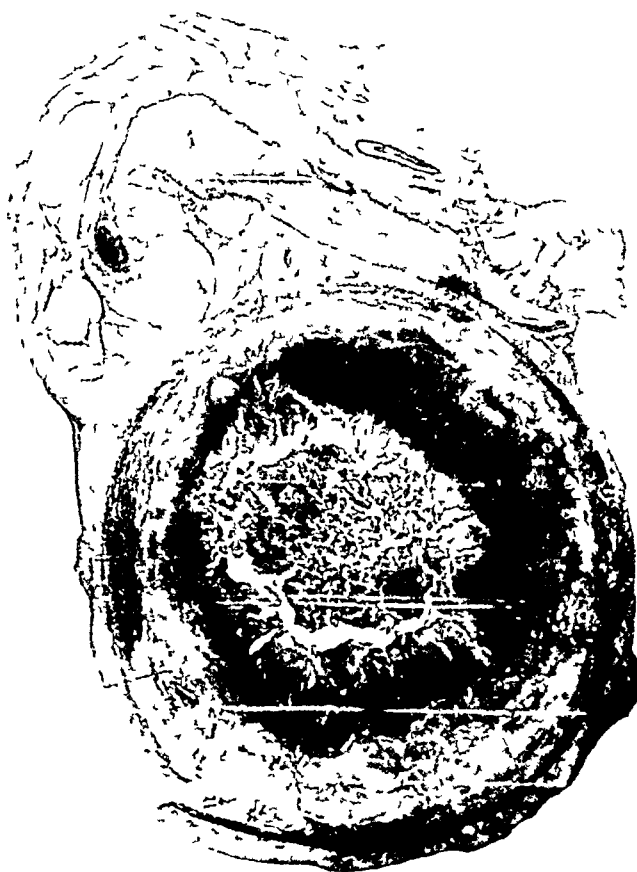


FIG 4—Acute intrinsic infective appendicitis Lumen filled with purulent exudate mucosa necrotic, distended muscular coats partly necrotic



FIG 5—Extrinsic infective appendicitis dependent upon invasion from a tuberculous peritonitis inflammatory process located upon the peritoneal coat here there is an abundance of granulation tissue and chronic inflammatory cells



FIG 6—Syncongestive appendicitis Note the degree of congestion and oedema with relatively slight cellular infiltration

## FOUR KINDS OF APPENDICITIS

Fig 3 is a drawing from the radiograph of a case of irritative appendicitis. It illustrates the condition of a wearied ascending colon, tired out by persistent over-stimulation from nerve elements irritated in the contracting connective tissue of the appendix. The distention of the ascending colon is readily diagnosticated by ordinary percussion. The percussion note of the right side of the abdomen in these cases is suggestive of the percussion note of a cider barrel in January. The percussion note of the left side of the abdomen in these cases is suggestive of the percussion note of a cider barrel in October. If we keep in mind the picture of the different percussion notes of a cider barrel in October and in January, the diagnostic value of this sign will be given its proper value in cases of irritative appendicitis or of chronic appendicitis of any sort, but not of appendicitis of an acute infective kind. The latter has not had time to weary the ascending colon with

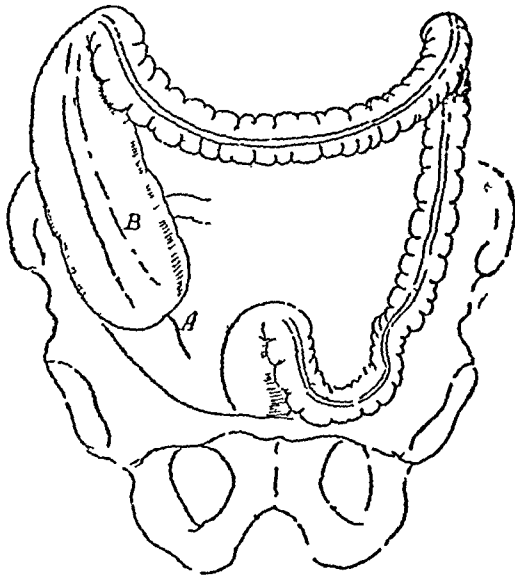


FIG 3 —Outline constructed from a radiograph of a case of irritative appendicitis, showing distended ascending colon wearied by over-stimulation from nerve elements irritated in appendix

persistent nagging. Although Senn was the first to give a definite name to normal involution of the appendix, his term of "obliterating appendicitis" does not seem to ring quite true to the facts. His nomenclature carries the idea that it is an "itis" which causes the obliteration.

As I look at the matter the "itis" does not cause the obliteration. The "itis" appears to be incidental to irritation of nerve elements entrapped in connective tissue in an appendix which is becoming obliterated in the course of a normal involution process. Should this view of the situation be verified by other observers a convenient name for the condition might be the one employed in this paper, "appendicitis irritans". The term would not define exclusively because syngonistic appendicitis and the scar tissue left after acute infection of the appendix would remain for classification among irritative lesions. These two lesions, however, represent minor phases of larger conditions which are sufficiently well described in their respective categories.

Hence, "appendicitis irritans" will serve at least for convenience in nomenclature when applied to a condition in which the irritation phase has major value throughout the entire history of a case

Concerning diagnostic point number three Why are the pains in the appendix region transitory and not continuous? Presumably because in the presence of any chronic irritation a certain degree of immunity is developed This immunity varies with so many factors in the general condition of the patient that we cannot say why the pain should be present on one occasion more than on another We may recognize the fact, however, and employ it for our purposes. There is no need in this brief paper for describing the incidental gastro-enteric disturbances which go with irritative appendicitis Such disturbances are due in part to the presence of the irritated appendix and in part to faulty organic processes belonging to the habitus of the kind of patient who is most prone to have fibroid degeneration of the appendix Patients with irritative appendicitis will obtain many opinions from many doctors The question of operation is one requiring nice judgment and a guarded statement about the prognosis of the patient's condition after operation Some patients find that the fibroid appendix was not a dominant factor in their troubles after all

*Acute Intrinsic Infective Appendicitis*—In this particular contribution to the subject little need be said about the form of appendicitis which has attracted the largest measure of attention It has engaged attention because of the violence of its demonstration, rather than because of its frequency of occurrence as compared with the irritative lesion of fibroid degeneration of the appendix Acute intrinsic infective appendicitis has come to stand for all appendicitis by synecdoche in the professional mind as well as in the lay mind For this reason there is much confusion of idea and blurring of the picture when a patient with any one of three other kinds of appendicitis goes to a consultant who has not made clear mental definition of types of appendicitis The acute intrinsic infective type of appendicitis appears to stand in second position as regards frequency of occurrence It is my belief that acute intrinsic infective appendicitis depends upon more than one causative factor, yet all causative factors lead toward two determining phenomena Rosenow has demonstrated the fact that the appendix tissue shows elective affinity for certain toxins appearing in the circulation and proceeding from some distant focus of infection Waste products in the circulation also may belong among toxic products We know that an extension of inflammation of various kinds from the cæcum into the appendix may engage the appendix in a particular response of its own peculiar kind We know further that the presence of entozoa or of concretions may excite local inflammation of the appendix We know that angulation or any other form of damming of the proximal end of the appendix may lead to retention of contents

which then undergo decomposition, with the production of toxins capable of producing direct toxic destruction of cells. At this point I would call attention to two peculiar features belonging to the appendix and distinguishing its infective inflammatory history from the inflammatory history of other parts of the bowel.

*A* The soft elastic inner coats of the appendix cannot swell readily within the less elastic outer sheath of peritoneum, when swelling has been caused by elective affinity for toxins, by extension of inflammation from the neighboring cæcum, by the irritation caused by foreign contents, or by damming of the outlet of an appendix lumen. The swelling inner coats suffer from compression anæmia because of their inability to expand freely within the comparatively inelastic outer sheath of peritoneum. Tissues which are anæmic from compression or from any other cause have lost their normal degree of resistance to bacterial invasion. They are no longer protected by the defence mechanism elaborated rapidly when blood and lymph transportation of defence materials occurs freely in the presence of infection.

*B* The other distinctive feature belonging to acute intrinsic infective appendicitis consists in proliferating endarteritis of the blood-vessels of the appendix. The appendix is a long peninsula having but one chief line of communication for supplies. It is cut off from these supplies when blood-vessels of its mesentery are engaged in proliferating endarteritis.

Proliferating endarteritis involving a part of bowel wall elsewhere may not be seriously destructive because of the freedom of collateral circulation, but in the appendix peninsula such collateral circulation cannot be fully effective under normal anatomic conditions in pathologic state. The symptoms and treatment belonging to acute intrinsic infective appendicitis are not described in this paper.

Fig. 4 is from a cross-section of a case of acute intrinsic infective appendicitis. The walls of the lumen are dilated and filled with purulent exudate. Mucosa is necrotic, inflammatory cells extend through the walls and out upon the serosa. The distended muscular coats are partly necrotic. Rhexis and œdema are in evidence.

*Extrinsic Infective Appendicitis*—This form of appendicitis is due to extension of infection from some other structure in the vicinity (ovarian abscess, pyosalpinx, or tuberculosis of the peritoneum, for example). Infection extending from other structures includes the appendix extrinsically. The tissues of the appendix in such case having been forewarned are forearmed. The armed peritoneal coat forbids development of rapid changes in the soft inner coats leading to fatal compression anæmia or to direct toxic destruction of cells. In a typical case of extrinsic infective appendicitis, the appendicitis is of secondary importance and is frequently discovered for the first time by the surgeon who is operating for the relief of



some other condition. It is not so often discovered by the diagnostician in advance of operation. The reason for that is because the infection which happens to include the appendix in its range is presenting symptoms of its own kind in major rôle at the moment.

Sometimes the complication of extrinsic infective appendicitis becomes the prime feature of a case, but this is not the rule. The history of a case of acute extrinsic infective appendicitis is different from the history of a case of intrinsic infective appendicitis not only because of a different kind of response to infective invasion, but also because adhesions have often formed in such a way as to allow fairly good blood or lymph circulation for the tissues of an extrinsically infected appendix.

Fig 5 is from a case of extrinsic infective appendicitis dependent upon invasion from a tuberculous peritonitis. The inflammatory process is localized upon the peritoneal coat where there is an abundance of granulation tissue and chronic inflammatory cells.

*Syncongestive Appendicitis*—One kind of irritative lesion and two kinds of infective lesion of the appendix have been described so far in this paper. Syncongestive appendicitis is a term that I have applied for convenience in nomenclature to a second and quite distinct irritative lesion. The term, "appendicitis syncongestiva," is an appellation which may help one to carry in mind the idea of an appendix which is congested synchronously with ordinary congestion of other structures in the vicinity. This may occur with many forms of obstruction to the blood and lymph circulation of the cæcum and ascending colon. For example, it is a common complication of general enteroptosis.

The reason why the appendix presents symptoms of its own peculiar sort in cases of syncongestive appendicitis is probably because the soft inner coats of the appendix attempt to swell within the less elastic outer sheath. For that reason, perhaps, there is pain at the appendix site, pain which would not appear at any readily distensible part of the bowel.

In cases of syncongestive appendicitis the factor of special compression anæmia may really lessen the defence apparatus of soft inner coats of the appendix, very much as it does in cases of infective lesions of the appendix because anæmic tissues are particularly vulnerable to bacterial invasion. On the other hand, the defence mechanism acting throughout the entire cæcum, ascending colon and appendix simultaneously appears to protect the appendix fairly well in cases of syncongestive appendicitis. In other words, the appendix swelling appears to rise and fall along with the swelling of cæcum and ascending colon. The expression, "rise and fall," applies particularly to the question of interstitial infiltrates.

Fig 6 is from a case of syncongestive appendicitis occurring in a young man sent to the hospital with a diagnosis of paratyphoid fever.

## FOUR KINDS OF APPENDICITIS

This specimen shows a serous infiltration of all structures of the appendix. There is also some cellular infiltration consisting principally of eosinophiles. Subserous blood-vessels are dilated. The particular feature of the case rests in the degree of congestion and oedema with relatively slight amount of cellular infiltration.

Painful symptoms in the appendix region attracted more attention than did other symptoms in this case, and it was deemed advisable to remove the appendix. At the time of operation the ascending colon and cæcum were found to be involved in a similar form of inflammation. Removal of the appendix was probably unnecessary, although it did not happen to be harmful. Cultures taken from areas of pyorrhœa showed that this patient was suffering from an overwhelming dose of *Streptococcus viridans*. Inflammatory abdominal symptoms gradually subsided when attention was given to the focus of oral infection that had been manifesting itself apparently by way of elective affinity on the part of the enteron.

The appendix disturbance presented features of an irritative lesion rather than those of an infective lesion. The irritative lesion of syncongestive appendicitis occurs most frequently in various chronic obstructions of the blood and lymph circulation, but this particular specimen from a case of acute inflammation happens to be the only one which I had at hand at the time of preparation of the paper.

Syncongestive appendicitis does not often call for operation. The symptoms of local pain and tenderness disappear when the swelling of the cæcum disappears or when tolerance toward chronic swelling of the appendix has become established.

# ENTEROSTOMY AND THE USE OF THE OMENTUM IN THE PREVENTION AND HEALING OF FISTULA\*

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THE operation of enterostomy is a life-saving procedure the necessity for which may be discussed a few hours longer than that of making a tracheotomy. When indicated, it is just as much an operation of necessity or emergency as the latter. Both procedures have indications and marked limitations for obstruction which is mainly mechanical.

Obstruction of the bowels may result from the toxemia of disease, either local or general, or from adhesions or paresis due to acute or chronic local or diffuse abdominal inflammation. A loop of bowel may become caught beneath a peritoneal band formed from some old infection long since healed. Conditions resembling intestinal obstruction may occur from reflex causes secondary to acute diseases of the kidney.

In the large majority of cases the intestinal obstruction for which the operation of enterostomy is indicated occurs during the first few days following an abdominal operation. The obstruction may be in the large or the small bowel, when in the large bowel a longer time is given for discussion as to its cause and method of treatment, the danger from toxemia is not as serious as in obstruction of the small bowel. In colonic obstruction the danger is from exhaustion or peritonitis resulting from perforation. Visible peristalsis extending irregularly over the abdomen is often noted. Such peristaltic waves are less noticeable in obstruction of the small bowel unless the obstruction is low in the ileum, and is incomplete and chronic. The danger of colonic obstruction following operation is greater when the operation has necessitated any suturing of the bowel. The lower the injury in the intestine the greater the danger of infection from the suturing of the bowel because of the difference in the type of bacteria commonly found in varying portions of the intestine. In the small intestine there is the added toxæmia of retained secretions and ferments which are delivered to the blood through the lymphatics without the protective influence of the liver which is exerted over the absorbed secretions of the colon (Draper).

In certain abdominal operations involving suturing of the middle or left colon an appendicostomy may be made as a safety-valve to take strains off the suture line, or a small tube may be passed into the rectum, high in the sigmoid, and left there during the first few days following the operation.

After abdominal operations there is usually stasis of peristalsis during the first twenty-four hours. This follows the injury of the peritoneum and is a protective measure occurring after the perforation of ulcers, gunshot wounds, or other abdominal injury, and giving time for the formation of life-saving adhesions.

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In children, abdominal operations are performed chiefly for one definite purpose and exploration is rarely indicated. In adults, the diagnosis of the essential lesion may be most accurate, yet complications or other disease may be present. It is, therefore, best in most cases other than acute infections to explore for associated disease even though such examinations may be the cause of additional gas colic and stasis following operation. A patient who has had an abdominal operation will probably have some stasis the same day and it should not occasion worry if the condition persists until the next night, even though it may be the cause of considerable pain. Various enemata are given the day following the operation, usually with complete relief. If the patient is not relieved, lavage laxatives, different kinds of enemata, hypodermic injections of pituitrin or eserine are given during the second night and third day. If these do not bring relief it may be concluded that the obstruction is complete. The patient vomits and is toxic from the small bowel secretion. The evening of the third day or the morning of the fourth he is taken to the operating room, the sutures are removed, the incision opened and the abdomen inspected. When there is general peritonitis the intestines are red and inflamed or lymph-covered. In such cases an enterostomy is made without exploration. If there is no evidence of general peritonitis the hand is inserted and passed to the site of the operation, which, in acute or chronic abdominal sepsis, is usually in the pelvic or right iliac region. In the search for obstruction at this early stage the adhesion causing the condition readily gives way and the gurgling of moving gas is felt and heard. When this occurs, enterostomy is not required. If operation is delayed until late in the fourth day, or even later, there may be toxic paresis as well. In some cases local abscesses are formed, but practically all patients who survive usually recover from the obstruction spontaneously with natural movements eight days from the day of its occurrence, life having been saved by the safety-vent. Patients with obstruction beginning some days following operation usually present the same symptoms at the same period from the day the obstruction began. In such cases bands of adhesions are the principal factor.

Enterostomy is less favorable for diffuse peritonitis than for localized obstruction. In the colon, obstruction is relieved by appendicostomy, cæcostomy, colostomy or the Brown operation of ileostomy. There is rarely spontaneous recovery from obstruction of the large bowel, a second operation being required for permanent relief and the restoration of the anal function.

**TECHNIC**—In early operation reopening of the incision is preferable. The advantage of this is that little or no anæsthetic is required for the whole procedure. In late operation a second incision is occasionally advisable. A low-lying loop of distended bowel is elevated into the incision. A segment is freed of gases or fluids and controlled by rubber-covered forceps applied above and below the point selected for perforation. At a point opposite the mesentery a purse-string suture of silk is applied in a diameter of half an inch. The bowel is perforated in the centre of the

purse-string by a knife, or the perforation may be made by the method of J W Long, using the Paquelin or an electric cautery. A catheter, size 10 or 12, is inserted several inches into the intestine and held in place, after the purse-string is tied, by perforating its side with the same needle and tying it into place. This suture will hold for a few days only. It will then cut out of the tissues and may be removed with the catheter when the latter is withdrawn. Two successive purse-string sutures may be applied by the Stamm-Kader method, but the procedure most satisfactory is that of Witzel, *ie*, depressing the catheter into the wall of the bowel and suturing together the folds thus formed over the catheter for a space of an inch and a quarter. When the operation is made as a jejunostomy for feeding or for intestinal obstruction in children the Coffey method of incising the peritoneal and muscular layers of the bowel at the point of depressing the catheter into its wall conserves the lumen of the gut, the tube being placed between the mucosa and the wall of the intestine, and the peritoneum and muscle being approximated over the catheter. This method is rarely followed by a fistula. For additional security and also to favor closure of the opening, we have passed the catheter through the perforated omentum (Fig 1) and then for fixation have included the parietal peritoneum, the omentum and the intestine in three sutures. This method maintains a movable, even if adherent, intestine and the omental graft aids in closing the bowel opening by granulation.

Two unfortunate conditions may occur. (1) The loop of bowel chosen for the opening may be high in the jejunum, leaving but a limited length for nutrition. In this case rectal feeding (intravenous or subcutaneous infusions of saline) will aid until the adhesions subside and relief is obtained. (2) A fistula may occur at the point of enterostomy when it is made without the protection of the omentum. Should a fistula occur it may be blocked by inserting through it into the intestine an oblong button held by threads in the eyes or through a perforation in the obturator which hold it up against the wall of the bowel at the point of leakage, the threads are then passed through the perforations of a flat button on the skin side of the fistula. This method makes a closure until granulations fill the opening, when the thread can be cut and the inner button passes with the intestinal contents (Dowd, Pallister).

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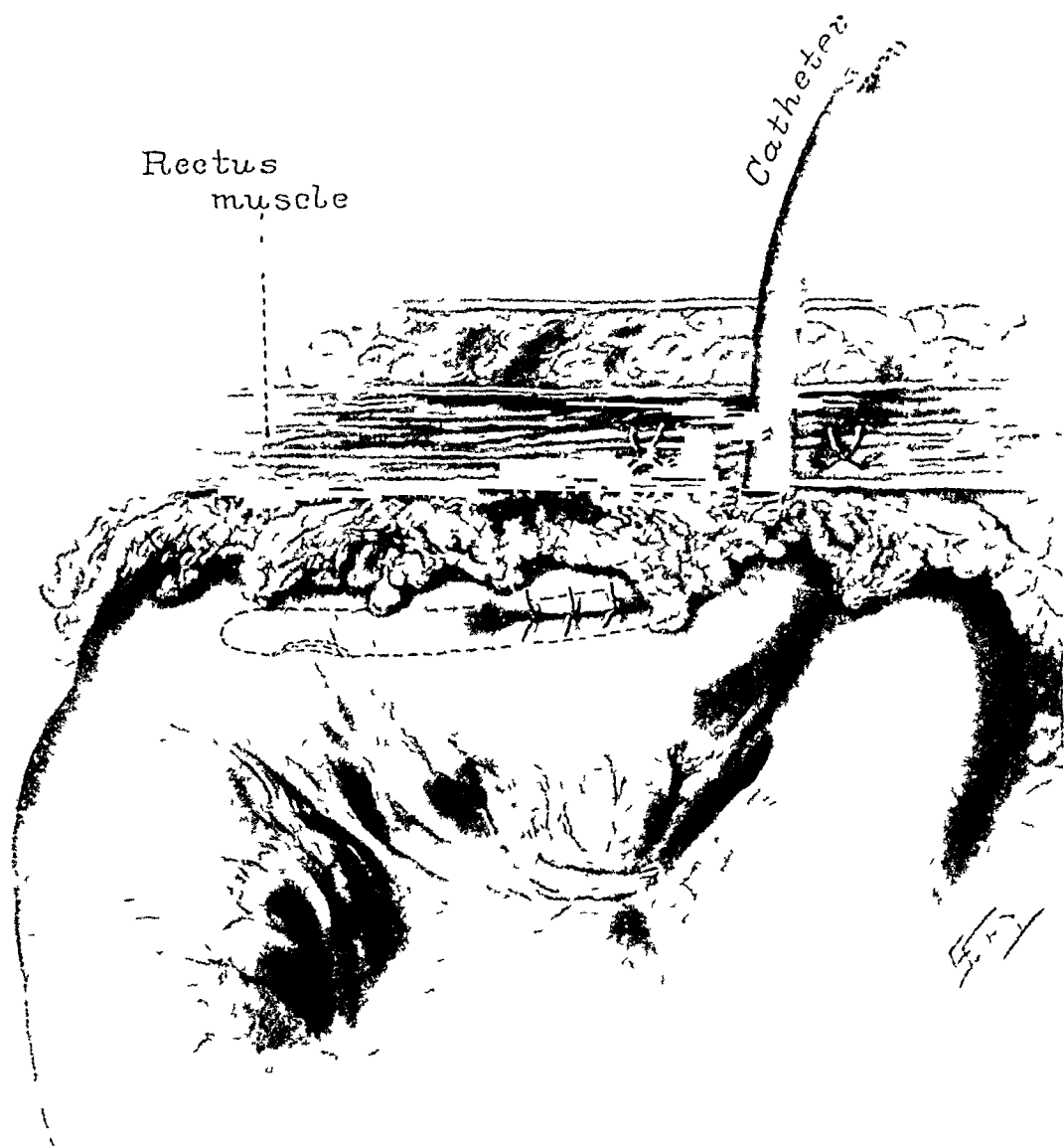


FIG 1 —Tube passing through the abdominal incision and the omentum and into the lumen of the bowel



# HISTOPATHOLOGY OF CARCINOMA OF THE TESTICLE

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THE morphological study of malignant tumors arising in the various glandular structures of the body has led in most instances to a satisfactory classification and a more or less definite knowledge of their histogenesis. Malignant tumors of the testicle have been carefully studied and in spite of many painstaking investigations, some of very recent date, a classification based on their histogenesis is still not definitely established. This fact led us to the study of these neoplasms with the idea, if possible, of identifying the types of malignant tumors of the testicle and of arriving at a satisfactory classification. In our series of cases we were unable to study any true sarcomata of the testicle and feel that we are unable to add anything definite to the various theories as to the origin of true teratomata. Our observations, therefore, will be limited to the question of the classification and histogenesis of carcinoma testis.

Langhans in a study of twenty-seven so-called alveolar carcinomata found only two containing cartilage and presenting other characteristics which would lead one to classify them as teratomata. The remaining twenty-five he describes as alveolar tumors with large polyhedral or polygonal cells, the protoplasm of which is somewhat granular and pale staining, the nuclei round or oval and vesicular in character. The stroma, which varies in amount, contains blood-vessels surrounded by leucocytes and occasionally infiltrated by lymphocytes. He believes that these tumors arise from the follicular epithelium of the seminiferous tubules and that the rete and straight tubules are only secondarily involved. When the latter are involved they may give rise to adenomatous or papillary carcinomata. He has pictured transitions from the tubular epithelium into true tumor and uses this observation as evidence to support his view that the tumor is a carcinoma arising from the tubular epithelium.

Wilms in a careful analysis of ten tumors finds that in many so-called mixed tumors we are really dealing with teratomata containing products of all three germinal layers. He admits the possibility of

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\* This study was carried on under the tenure of a Eugene Meyer, Jr., Fellowship and a Moses Heineman Fellowship



carcinomatous change in them but also contends that pure carcinoma may exist as an independent tumor arising from the seminiferous tubules. This latter contention, however, he is unable to prove.

Chevassu also found that the so-called mixed tumors are really terdernal teratomata. He mentions the possibility of overgrowth of one of the teratomatous elements which in extreme cases may completely dominate. Malignant transformation in the form of various types of carcinoma is also described and the author has in these instances found the tumors to be papillary in structure. He further carefully studied a type of tumor which he termed "seminome," believing it to arise from the spermatogonia. He differed from the opinion offered by Krompecher that these tumors were endotheliomata, and likewise disagreed with Monod and Terrillon as to their histogenesis. The latter authors considered these tumors to have their origin in the embryonic remains of the germinal epithelium. Chevassu differentiated quite definitely the so-called "seminome" from the lymphadenomata and lymphosarcomata. In contradiction to Hansemann he could find no evidence of relationship between these tumors and the interstitial cells of the testicle. He believed that these tumors arose from the cells of the seminiferous tubules nearest the basement membrane, because of the morphological, tinctorial, and chemical resemblance existing between the tubular cells and the tumor cells proper. He further believed that the illustrations of Tiggonie, Talavera, and Langhans showed definitely the transitions of certain seminiferous tubules into tumor. He himself could not find such transitional areas because of the advanced stage in the development of the tumors that he studied.

Debernardi in a study of four cases of large cell tumor of the testicle comes to the conclusion that these tumors are epithelial in origin and arise either from the developed cell of the seminiferous tubule or from the anlage of this structure. In an additional case he found carcinoma in a testicular teratoma with metastatic carcinoma in various organs, the metastases resembling the large round cell neoplasm found in the testicle. It seems probable that he was dealing with a metastatic large cell carcinoma of the testicle associated with a typical testicular teratoma (that is, two tumors), rather than with a teratoma that had become carcinomatous and in which the carcinomatous element had metastasized.

After an extensive analysis of eighteen cases Ewing came to the conclusion that all the large cell tumors of the testicle and, in fact, all carcinomata of the testicle are but extreme examples of "one-sided development of teratomata." He based his argument on the fact that in some of his cases of so-called simple tumor, careful study had shown them to be teratomatous in nature. Furthermore, in some of the teratomata he found carcinoma of various types. He claims that the simple carcinoma has a distinct morphology, and because of its resemblance to the carcinomata found by him in teratomata, he considers the simple

carcinomata to be true teratomata in which the carcinoma has completely overgrown every vestige of teratoma

Sakaguchi believes that the large cell tumors of the testicle arise from the epithelium of the seminiferous tubules, basing his belief on the fact that the study of serial sections has demonstrated the transition from the proliferating epithelium of the seminiferous tubules to the masses of tumor cells. He further describes a type of epithelial tumor with adenomatous structure and papillary proliferations composed of cells smaller than the elements forming the so-called "seminome" and often cuboidal in shape. He believes these tumors might arise from the epithelium of the tubuli recti.

We have studied twenty-six tumors of the testicle and have grouped them according to the following classification

<i>Carcinoma</i>	{ Medullary	Alveolar, seminome
	{ Adenomatous	{ With medullary areas Papillary
<i>Teratoma</i>	{ Without carcinoma	None studied
	{ With carcinoma	{ Adenomatous type with medullary or papillary areas

*Carcinoma*—Of the pure medullary type we studied sixteen, one of which contained masses of protoplasm with multiple nuclei somewhat resembling syncytium.

Of the adenomatous type we studied four examples all of which presented medullary and papillary areas. One of them contained in addition multinuclear protoplasmic masses similar to those mentioned above.

The medullary carcinoma corresponds to the alveolar carcinoma or "seminome" of other authors. Microscopically, these tumors are composed of masses of large polyhedral cells with pale staining, finely granular, often vacuolated protoplasm containing a large, round or oval, vesicular nucleus. The vacuoles in the protoplasm represent glycogen droplets which can be demonstrated by selective staining. Mitotic figures are of frequent occurrence. These cells are almost identical in appearance with the spermatogonia. The cells are arranged in groups and masses, in some areas mimicking tubules in their development. The stroma is composed of fairly broad connective-tissue strands, separating the larger groups of cells and containing many thin-walled vessels. Occasionally about these vessels and in the stroma lymphocytes and polynuclear leucocytes are found. In some of the neoplasms there seems to be a tendency for the tumor cells to arrange themselves about the blood-vessels, often giving the impression of a perithelial tumor. Finer fibrils radiate from these broad connective-tissue strands, further sub-

dividing the cell masses There is a marked uniformity in the cell contour and appearance The adenomatous type differs from the type described above

We find in these tumors typical adenomatous areas composed of glandular structures lined by cells smaller than those described as characteristic of the medullary type and lacking also the vacuolated pale protoplasm These cells are cuboidal or cylindrical, often irregular, the protoplasm staining deeply Here and there solid masses of these cells are encountered and often the adenomatous areas are thrown into papillary proliferations The stroma in this type is similar to that described in the medullary tumor, but areas of round cell infiltrations are more often encountered

*Teratoma*—Six teratomata containing carcinoma were studied In five the carcinoma was papillary adenomatous in type with scattered nests of malignant cells In two of this group small multinucleated protoplasmic masses were found<sup>1</sup> Only one contained purely medullary carcinoma, the cell type resembling that of the alveolar form found independently of teratoma

The carcinomata which are encountered in teratomata corresponded accurately to the type already described as adenomatous or papillary We never found a carcinoma in a teratoma that resembled the purely medullary type except in one instance, and in this case the tumor cells were smaller than those usually found

#### DESCRIPTION OF MATERIAL STUDIED

##### MEDULLARY CARCINOMA

*Tumor 1037*—Specimen consists of a rounded tumor, measuring seven centimetres in diameter, which has completely replaced the testicle The tumor is surrounded by the intact tunica and on section shows a uniform cellular appearance with a few scattered areas of necrosis

*Microscopical examination* Large, polygonal cell, medullary tumor The cells occur in large nests and strands Seminiferous tubules are still preserved, some imbedded in connective-tissue strands, others in tumor proper The cells of these tubules are identical in appearance with those of the tumor In places tumor and tubules are directly continuous with one another Origin of tumor from tubules indeterminable

*Tumor 2423*—Fixed specimen consists of testicle and adnexa Testicle is replaced by a tumor, twelve centimetres in diameter This tumor is enclosed by the tunica On section, it has a firm, white, cellular appearance, interspersed with bands of hyaline connective tissue

*Microscopical examination* Large, polygonal cell, medullary tumor In places there is definite connection with seminiferous tubules, tumor apparently arising from them

*Tumor 2294*—Fixed specimen consists of testicle and adnexa Testicle has been converted into a firm tumor, seven centimetres in diameter On section, the tumor is lobulated, the lobules separated by connective-tissue strands The tumor is surrounded by the intact tunica

<sup>1</sup> In another, an area of syncytial tissue surrounded by blood-vessels and clot and resembling the picture seen in chorio-epithelioma was present (Fig 6)

## CARCINOMA OF THE TESTICLE

*Microscopical examination* Large, polygonal cell, medullary tumor, in many places apparently arising from the tubules

*Tumor 1244*—Specimen consists of testicle and adnexa The testicle has been converted into a tumor, measuring ten centimetres in diameter There are no testicular remains The tumor is encapsulated by the tunica On section, the mass is traversed by bands of hyaline connective tissue The epididymis is enlarged, hard, and apparently involved by tumor

*Microscopical examination* Large, polygonal cell, medullary tumor having a tendency to perithelial arrangement

*Tumor 2085*—Fixed specimen consists of testicle and adnexa The testicle has been converted into a tumor, measuring eight centimetres in diameter On section, the tumor has a cellular appearance, the centre being shaggy and necrotic

*Microscopical examination* Large, polygonal cell, medullary tumor In places the solid alveoli seem contained within the sheaths of the seminiferous tubules and apparently have this epithelium as their source of origin

*Tumor 3697*—Fixed specimen consists of testicle and adnexa The testicle has been replaced by a rounded tumor, measuring nine centimetres in diameter The tumor is encapsulated by the tunica

*Microscopical examination* Large, polygonal cell, medullary tumor with a connective-tissue stroma whose fibrils ramify between small groups of cells

*Tumor 1654*—Fixed specimen consists of testicle and adnexa The testicle has been replaced by a tumor, measuring fifteen centimetres in diameter, which has a small rim of compressed testicular tissue at the upper pole

*Microscopical examination* Large, polygonal cell, medullary tumor, which gives the impression of arising from the seminiferous tubules In some of the areas the cell groups are contained in a limiting connective-tissue sheath resembling tubules Here, too, the resemblance between the tumor cells and the tubule cells is striking

In the tumor, areas composed of masses of protoplasm containing many nuclei were encountered

*Tumor 2918*—Typical large, polygonal cell, medullary tumor

*Tumor 5250*—Typical large, polygonal cell, medullary tumor

*Tumor 1620*—Typical large, polygonal cell, medullary tumor

*Tumor 3967*—Typical large, polygonal cell, medullary tumor

*Tumor 10107*—Typical large, polygonal cell, medullary tumor

*Tumor 9285*—Typical large, polygonal cell, medullary tumor

*Tumor 2618*—Typical large, polygonal cell, medullary tumor

*Tumor 1343*—Typical large, polygonal cell, medullary tumor

*Tumor 19344*—Typical large, polygonal cell, medullary tumor

## ADENOCARCINOMA

*Tumor 9863*—Specimen consists of testicle and adnexa Testicle has been converted into a tumor mass, measuring seven centimetres in diameter It is lobulated, the lobules being separated by connective-tissue bands The lobules are cellular and somewhat necrotic The tumor is completely encapsulated by tunica

*Microscopical examination* Large, polygonal cell, medullary type of tumor, showing papillary adenomatous areas

*Tumor 36*—Specimen consists of testicle and adnexa Testicle has been replaced to a great extent by a tumor mass, measuring eight centimetres in diameter The tumor is gray, soft, cellular, and shows areas of necrosis

*Microscopical examination* Large, polygonal cell, medullary tumor showing areas of papillary adenocarcinoma In many places there is a great proliferation

of the cells of the seminiferous tubules, and these have a marked resemblance to the tumor cells constituting the medullary portion of the neoplasm. Areas of apparent transition from tubule to tumor are also to be found. The papillary areas have slightly smaller cells and are circumscribed in their arrangement.

*Tumor 3417*—Fixed specimen consists of testicle and adnexa. The testicle is normal in size, the centre being represented by a shaggy necrotic mass which has crowded the testicle to one side. The mass has penetrated somewhat through the tunica, but over its greatest extent is surrounded by the tunica.

*Microscopical examination* Large cell, papillary and medullary tumor. There are areas in the testicle in which seminiferous tubules are seen full of cells resembling the tumor cells.

*Tumor 2227*—Specimen consists of testicle which has been converted into a tumor, measuring fourteen centimetres in diameter. Delicate hyaline connective-tissue bands traverse it. The centre is represented by a (degeneration) cyst, four centimetres in diameter, the wall being formed by tumor. The entire tumor is encapsulated by the tunica.

*Microscopical examination* Large, polygonal cell, medullary tumor with areas of papillary adenocarcinoma.

#### CARCINOMATA IN TERATOMATA

*Tumor 1429*—Fixed specimen consists of testicle and adnexa. The testicle has been converted into a tumor, measuring seven centimetres in diameter. The tumor consists of solid, cellular tissue, with hemorrhagic areas, and is traversed by large veins and hyaline connective-tissue strands. Small hyaline islands are seen scattered through the tumor and tiny cysts can be seen on the cut surface. The mass is encapsulated by the tunica.

*Microscopical examination* The tumor is composed of various types of epithelial cysts, embryonal connective tissue and hyaline cartilage. There are collections of malignant epithelial cells in groups and large nests. The cells are small and polymorphous with small densely staining nuclei.

*Tumor 2480*—Fixed specimen consists of testicle and adnexa. At the centre of the testis there is a tumor, five centimetres in diameter, surrounded by a thick fibrous capsule which is also infiltrated by tumor.

*Microscopical examination* The tumor is made up of masses of large, polyhedral cells with eccentric nuclei, in places adenomatous in arrangement. There are small groups of protoplasmic masses in strands with multiple nuclei and also large areas of compressed and hyaline testicular tubules showing no participation in the new growth. There are numerous epithelial-lined cysts of various types.

*Tumor 3099*—Fixed specimen consists of testicle and adnexa. The testicle has been replaced by a tumor, measuring eight centimetres in diameter. The tumor mass proper contains numerous small cysts isolated and in groups. Between them are small solid areas separated by fibrous strands. The tumor is encapsulated by thickened tunica.

*Microscopical examination* The tumor is composed of areas of hyaline cartilage and various types of epithelial-lined cysts. The more solid areas are made up of masses of large cells, polymorphous in appearance. Small areas of tissue, syncytial in character, resembling chorionic syncytium, are seen.

*Tumor 3759*—The testicle proper is represented by a compressed ring of tissue, thickest at the upper pole, where it measures three-quarters of a centimetre. The tumor is separated from the testicle by a definite fibrous capsule. The tumor is composed of solid areas traversed by fibrous bands and containing numerous cysts.

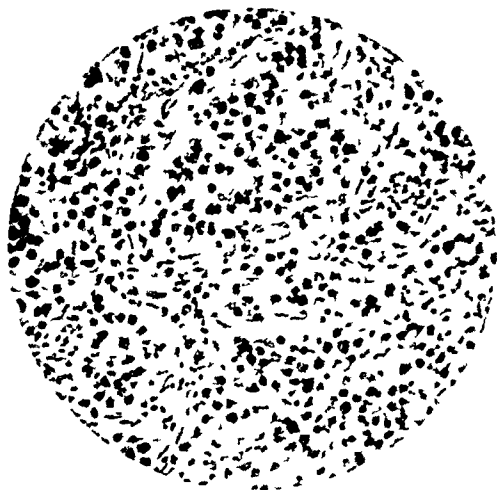


FIG 1—Medullary type of tumor, showing alveolar arrangement



FIG 2—Seminiferous tubule surrounded by tumor, illustrating morphological resemblance of tumor and tubule cells

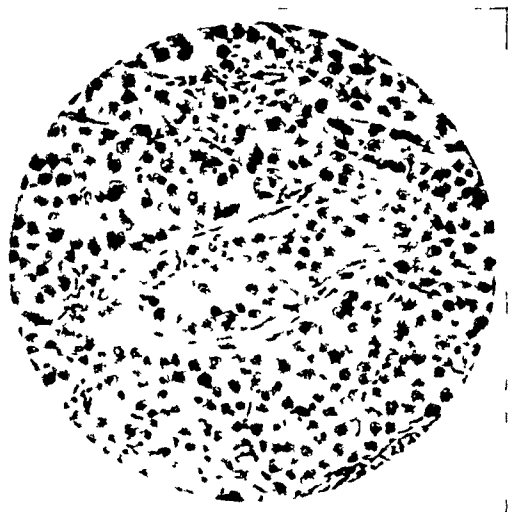


FIG 3—Tubule and tumor, showing morphological resemblance of their cells and apparent transition Tubule into tumor—tumor into tubule



FIG 4—Papillary adenocarcinoma found in a medullary tumor



FIG 5—Teratoma, showing epithelial cyst (squamous) and adenocarcinoma



FIG 6—Syncytium in intimate relation to an adenocarcinoma found in a teratoma



## CARCINOMA OF THE TESTICLE

*Microscopical examination* The tumor consists of cartilage and various types of epithelial-lined cysts. There are masses of small, deeply staining epithelial cells with areas of adenocarcinoma. Some areas of the stroma resemble spindle-cell sarcoma.

*Tumor 58*—Specimen consists of testicle and adnexa. The testicle has been replaced by a tumor, measuring seven centimetres in diameter. It has a cellular appearance and the surface is traversed by bands of connective tissue. To one side is a small encapsulated mass containing small cystic areas.

*Microscopical examination* The tumors show presence of cartilage and various types of epithelial-lined cysts. There are areas of medullary and papillary adenocarcinoma made up of small, irregular cells with dark, granular protoplasm and deeply staining, irregular nuclei (Fig 5).

*Tumor 12612*.—*Microscopical examination* The tumor is composed of areas of cartilage and various types of epithelial cysts. There are also masses of solid and papillary adenocarcinoma. In addition there are areas of multinuclear cells.

### DISCUSSION

A consideration of the views of the various authors cited shows that the most common tumor of the testicle is the large cell alveolar type which has been classified both as a sarcoma and as a carcinoma. The more recent studies of the histogenesis of these tumors have definitely demonstrated that these neoplasms are epithelial in nature (Chevassu).

The twenty non-teratomatous tumors studied by us, with four exceptions, present a complete uniformity of structure, and correspond to the large cell, solid or alveolar tumors, "seminome." We believe, as does Chevassu, that the large cell tumor arises from the epithelium of the seminiferous tubules. The other types of carcinoma might arise from the tubuli recti, although this could not be proven.

The four exceptions mentioned above show medullary, large round cell areas, and in addition adenomatous and adenopapillary portions.

The malignant tumors associated with teratoma we found very different from the solid type just mentioned. As noted previously, these tumors are almost entirely adeno-papillary in structure with scattered small and large nests of malignant cells. The cells are usually cuboidal or high cylindrical, the protoplasm not being vacuolated or granular, and taking an intense stain. The nuclei of these cells are elongated, oval, and usually basally placed. The occasional solid cell nests which are found in these papillary tumors are generally composed of the same type of cell that is found in the papillary portions. The medullary areas in only one tumor resembled the typical "seminome" type of Chevassu.

It would seem probable that in an epithelial organ, such as the testicle, the most frequent type of neoplasm should be epithelial in nature, and as the only truly epithelial elements of the testicle are the seminiferous and straight tubules these tumors would logically be expected to arise from these structures.



The cells of the medullary or alveolar carcinoma correspond closely to the spermatogonia and spermatocytes of the seminiferous tubules and in some of the tumors are identical in appearance, as shown in the accompanying illustration (Fig 2)

In a few instances the tumor appears to arise directly from the cells lining the seminiferous tubules (Fig 3) In most of the specimens, however, the tumor has so overgrown the testicle that the source of origin cannot be traced

The cells constituting the papillary adenomatous malignant tumors associated with teratomata in most instances resemble morphologically those lining the tubuli recti rather than the cells lining the seminiferous tubules

There remain for consideration the papillary adenomatous portions found in the four cases of medullary carcinoma These areas are composed of cells not at all resembling those of the medullary portions but are similar to the cells of the papillary adenomatous areas occurring in the carcinomata associated with teratomata

The origin of the two types of tumor, the medullary and the adenomatous, has not been definitely determined While we have no absolutely conclusive evidence, we believe that the large cell type of tumor takes its origin from the epithelium of seminiferous tubules, basing our opinion on the morphological resemblance between the cells of the tubules and those of the tumor We have been able to find areas where the relationship between tumor and tubules is such that the origin of the former from the latter appears most probable (Fig 3)

The adenomatous type of tumor has the characteristics of adenomatous tumors of other glandular organs (Fig 4) The cells do not resemble either in morphology or arrangement those lining the seminiferous tubules The adenomatous neoplasms constitute a type differing markedly from the medullary tumors, and it may not be amiss to suggest that, because of their adenomatous structure and their cell type, they probably arise either from the tubuli recti, or when associated with teratomata, from the glandular structures in the latter

There is one other possibility to account for the existence of the adenomatous elements so rarely encountered in the medullary tumors We have seen but four examples of this among twenty specimens We can accept here either a double source of origin for the two types as described or can suggest the possibility of an adenocarcinoma arising from the seminiferous tubules which, because of their tubular nature, can be conceived of as giving rise to an adenomatous tumor

Ewing in his study of carcinoma testis has come to the conclusion that all carcinomata of the testicle are a one-sided development of teratomata He bases his opinion on the following observations In a number of teratomata he found carcinomata that resembled histologically those carcinomata which occur without the presence of teratomatous

elements Because of this resemblance he concluded that all carcinomata of the testicle represent teratomata in which the teratomatous elements have been overgrown by the more rapidly growing carcinoma Not only does he find a similarity in the individual epithelial elements, but the stroma in the tumors, "lymphoid" as he terms it, is similar and is regarded by him as an integral part of the tumor and of value in identifying these neoplasms As the result of our study we have not been able to classify all carcinomata as one-sided teratomata in their development Many teratomata testis have been described in the literature in which no carcinomatous elements have been found after a most painstaking search, and, on the other hand, most carcinomata show no evidence of teratoma

In Ewing's series of eighteen cases of carcinoma, teratomatous elements could be demonstrated in only eight specimens, while in our twenty-six cases only six tumors contained teratomatous structures In the eight cases in which Ewing could demonstrate teratomatous elements, purely medullary tumors were found only three times, while in five, adenomatous tumors were present Of these five, two also contained medullary areas In the six cases in which we found teratoma five of the carcinomata were adenomatous, one only containing medullary areas

The most frequent type of carcinoma of the testicle is the one described by us as medullary This is identical with the "seminome" of Chevassu We find, as does Ewing, that in the teratomata this medullary type is not the usual one

In our investigation of the various types of carcinoma we studied the character of the stroma, but found that it varies in the different types of tumor In the adenomatous tumors and in those commonly found in teratomata the so-called "lymphoid stroma" is at times present, while in the pure medullary type it is of comparatively rare occurrence Because of this variation we are unable to identify the tumor type from the constituents of the stroma

In view of the fact that the epithelial elements of a teratoma vary in type, it seems to us that a carcinoma arising in such a teratoma would present variations in its structure resembling, more or less, the particular epithelial group from which it took its origin

However, carcinomata of the testicle, with very few exceptions, can be classified as one simple type, which to us seems to indicate that they most probably develop from a single constantly present histological structure This, in our opinion, is the best argument for believing that the medullary (large cell alveolar) carcinoma does not represent a one-sided development of a teratoma but is a primary tumor of the testicle itself

## SUMMARY

1 The commonest type of tumor of the testis is medullary in character, and is commonly described as a large cell alveolar tumor

2 The cells of the medullary tumors histologically bear a close resemblance to the cells of the seminiferous tubules

3 There are areas in some of the medullary tumors that suggest direct transition from tubular epithelium to tumor cells

4 The common type of carcinoma associated with teratoma is adenomatous in character

5 Adenomatous tumors may have their origin either from the tubuli recti, from adenomatous structures of a preexisting teratoma or possibly from seminiferous tubules

6 The medullary tumors we believe are primary tumors of the testicle arising from the seminiferous tubules

We wish to express our grateful appreciation to Dr F S Mandlebaum, Director of the Laboratory, for his kindness in making the excellent photomicrographs which accompany this article

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# THE UNIVERSITY HOSPITAL SHOULDER SPLINT

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THE modern conception of shoulder support after injury, bursitis or fracture in this region, is summed up in abduction and external rotation

To accomplish abduction in the most direct and simplest manner is highly desirable Plaster-of-Paris spica of the shoulder, triangle splints and aeroplane splints all have their advocates

In Fig 1, I wish to present a simple and easily made splint which accomplishes this object

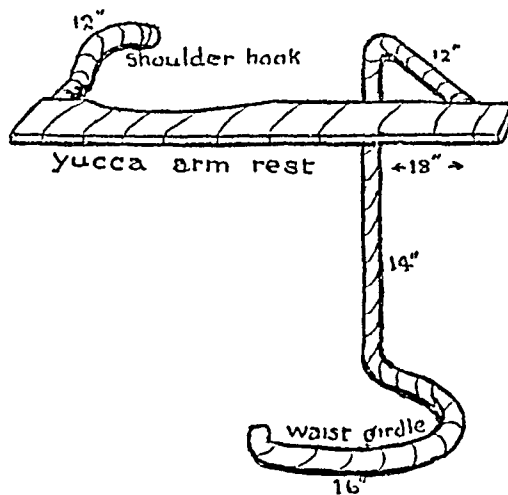


FIG 1 — The shoulder splint

It is constructed of a rod of iron  $\frac{3}{8}$  inch thick and six feet long This is bent in a vise or wrenches first into a girdle 16 inches long to rest about the flank, either above or below the iliac crest, an upright section at right angles, 14 inches long, an arm projection 12 inches long, bent at a right angle in the plane of the girdle support, a forearm section, 18 inches in length, in the plane of the latter, bent at an acute flexion, and a hook over the opposite shoulder so adjusted that it rests over the trapezius, not on the scapula

A thick yucca board, cut concave to fit the chest at its wrist segment, is strapped on the iron frame with adhesive The girdle and shoulder hook are heavily padded The whole splint is covered with cotton sheeting and gauze bandage It is then ready to slip on the patient, where it should be adjusted to fit comfortably It then stays in position without support In the early stages of the immobilization it is advisable, however, to run a couple of laps of broad muslin bandage

beneath the girdle, over the opposite shoulder, where a generous pad should be placed, and also once or twice about the waist, as indicated by dotted lines in the picture. Also an adhesive strap may join the hook over the shoulder, across the back to the angle in the axilla. This gives increased stability.

Careful adjustment of all pressure points is necessary to avoid discomfort.

This splint is best applied over a thick undershirt. It is very light and can be made in twenty minutes. Where external rotation is necessary in addition to abduction, this splint will not serve. One made on the lines of a Cabot leg splint with its wide base resting on the flank or hip, its short arm against the body and its long arm extended in a position of extreme abduction, will answer the requirements perfectly.

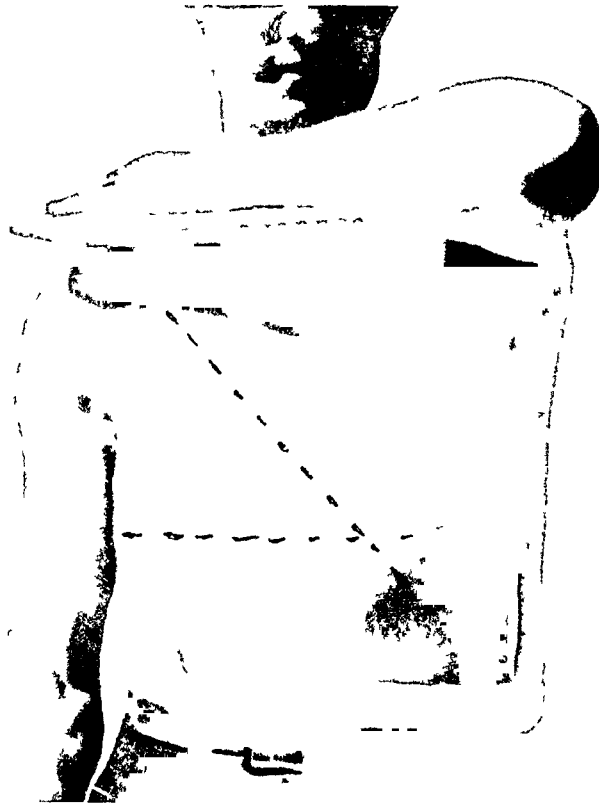


FIG 2 —The shoulder splint applied



# AN EVALUATION OF ASEPSIS AND ANTISEPSIS

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It would seem obvious that the greatest care should be exercised in the operating room looking toward the prevention of sepsis. Nevertheless, a hospital executive of wide experience recently expressed to the writer a doubt (shared by many), as to the necessity of all of the usual elaborate precautions. The investigation which led to the writing of this paper was undertaken for the purpose of learning, if possible, what is and what is not essential.

Under normal conditions the steam sterilizer is dependable. We are ordinarily assured of sterile draperies, gowns, dressings, instruments, and suture material. Catgut prepared by the operating room staff was at one time a menace, but the modern tube gut kept in a 1-500 mercuric chloride solution and placed in alcohol 95 per cent shortly before use is safe. Catgut is not now the surgeon's alibi as formerly, nor is it fair for the operator to place upon the operating room nurses or assistants an onus which perhaps should attach to himself.

For example, preservation of the normal resistive and recuperative powers of the tissues is an important measure of prophylaxis against infection as emphasized by Whiting and Slocum<sup>1</sup>. To this end bleeding points in the incision should be clamped and immediately tied off. Clamps allowed to remain for a time produce necrosis and there is no assurance that hemorrhage has been permanently controlled. Devitalization of tissue and blood clots favor infection.

Many operators are heavy handed. They should cultivate gentleness. The incision must be ample to avoid pulling and hauling at its margins, and retractors should be placed carefully. The writer has never subscribed to the dictum that the hands had best be kept out of the incision. An unpunctured rubber glove is neither more nor less sterile than an instrument since both have been made aseptic by boiling, and the touch of rubber-encased fingers is surely less traumatizing than the harsher contact of metal. The deeper strata of the incision should be protected by walling off the skin edge with towels, as perfect asepsis of the skin is perhaps unattainable.

Indeed, the problem of skin disinfection is extremely serious, as illustrated by the following report. From a hospital doing excellent work in a large city comes the statement that during one week on the surgical and gynecological services 22 operations were performed. Primary union occurred in but 13 cases. The remaining 9 patients all suffered from some form of sepsis, as a result of which 4 died. Twelve cases were operated upon in the orthopaedic service during the same period without an infection. To this report is appended an explanatory note. "The occurrence of a high



percentage of post-operative sepsis as shown in these series of cases demanded investigation. Careful bacteriological studies were made of every possible source of infection. Bacteria were grown in several cases, but only from the field of operation before the incision was made. This indicated that the method of cleansing the skin of the patient for operation was at fault. McDonald's solution had been recently introduced in place of the tincture of iodine as a routine procedure, and was therefore given up when the report of the bacteriologist was that bacteria were found in cultures from the skin and that the solution itself has distinctly less penetrating power than the tincture of iodine.

"At the time of the operation it was stated that our use of McDonald's solution was tentative only. The objections to it, noted at that time, were that the coal-tar derivative employed was a proprietary preparation, the exact composition of which was not known, and that it was put on the market as a household and general disinfectant and bactericide, without guarantee as to strength or purity. These points in themselves should have been sufficient for its rejection, but we were influenced by the enthusiastic reports of others, and did not make bacteriological studies before adopting it. Attention is called to the difference between the results of the orthopædic and the other services as to sepsis. Practically the only difference in the technic was in the method of preparation of the field of operation, the tincture of iodine and not McDonald's solution being used in the orthopædic cases."

The difficulty of skin sterilization has long been recognized. Whiting,<sup>2</sup> who has investigated the subject at length, reminds us that the older surgeons scrubbed the skin industriously and long in the hope of securing surgical cleanliness, merely, as asepsis was considered unattainable. Whiting states that the methods of skin sterilization comprise (1) The wet method, which consists of mechanical scrubbing with green soap, shaving and the application of some antiseptic. Prolonged scrubbing with warm soap and water encourages the migration of bacteria to the surface where they can be removed, but it damages the skin and lowers resistance.

The antiseptics commonly used are alcohol, thymol, iodine, and the biniodide and bichloride of mercury. The latter has very little germicidal action in aqueous solutions as demonstrated by Post and Nicoll. "They are absolutely ineffective where prompt disinfection is required, as in the disinfection of the hands and fields of operation." Bichloride coagulates albumen and aqueous solutions cannot penetrate the deeper layers of the skin. Whiting believes that alcoholic solutions of bichloride are much more efficient, especially on a dry skin. Harrington's solution destroys germs in from thirty seconds to two minutes. It is irritating to the skin. Various observers disagree as to the germicidal power of alcohol in different strengths. It is widely lauded as a vehicle for other antiseptics because of its power of penetration. As a solvent or vehicle for the various antiseptics used on the skin, it is vastly superior to water, the alcoholic solutions pene-

trating more deeply and having greater germicidal power than the aqueous Grossich, in 1908, recommended that after shaving the operative field iodine, 10 to 12 per cent in alcohol, be applied to the dry skin (2) The dry method of sterilization may be carried out as advised by Grossich, or the field may be rubbed with bichloride, 1-1000 in 70 per cent alcohol solution (3) The combined method consists in thorough washing and scrubbing and covering the field with a dry, sterile dressing as a preliminary, and an application of an antiseptic to the dry skin eight to ten hours later with a second application on the table

Whiting believes that the forces of nature will sterilize the skin absolutely, although germicides will not, with certainty He has observed that people who bathe frequently, or those who sweat profusely, are less liable to infection of wounds, the skin being washed from within outward

In tests made by Whiting for skin sterility before neutralization of the antiseptic nearly all cultures were negative, after neutralization 60 per cent showed growths In about 85 tests made one-half hour after preparation by both wet and dry methods a growth was obtained in all except two instances, the bacteria being brought to the surface by the natural activity of the skin In tests of the sterility of the hands the number of bacteria from the surface decreased with each operation, the hands being scrubbed and incased in rubber gloves between each two operations After the seventh or eighth operation the surgeon's hands were sterile and remained so until contaminated from without In another series of tests the skin was artificially sweated by a hot application of glycerine and kaoline for four twelve-hour intervals All cultures were negative at the end of the forty-eight hours

Serious investigation of the actual and relative value of antiseptics was first instituted, according to Post and Nicoll,<sup>3</sup> by Koch in 1881 The "thread method" of Koch consists in drying bacteria on threads and suspending them in the solution to be tested Kronig and Paul, in 1897, devised the "garnet method" by which bacteria dried on garnets are immersed in various germicides. In 1903 Rideal and Walker described their "drop method" in which a certain quantity of broth culture of bacteria is added to a given amount of the solution to be tested The method of procedure of Post and Nicoll is as follows One-half c c of the solution to be tested is placed in a small test-tube Into this solution is deposited one platinum loopful of an emulsion (in culture broth) of a twenty-four hour culture (on blood-agar slant) of the organism used After various intervals a loopful of the contaminated test solution is thoroughly mixed into a tube of blood-agar and plated Observations are made after incubations of twenty-four, forty-eight and seventy-two hours Although clinical conditions are not simulated a most favorable opportunity for action is afforded, and from the uniformity of results conclusions may be drawn as to relative activity Tests demonstrated the prompt action of green soap, alcohol above 50 per cent, silver nitrate as dilute as 1-1000, the iodine solutions, either as the

tincture or in aqueous solution with potassium iodide, and prenil 5 per cent This investigation emphasized the unreliability of chemicals formerly supposed to be efficient, and the extremely slow action of mercuric chloride

Bovee<sup>4</sup> concludes, as a result of numerous scraping cultures, that 5 per cent tincture of iodine sterilizes the skin after a period of time from two minutes to fifteen minutes from its application The inhibitive action of alcohol is great but is increased by the addition of iodine After the application of three coats of iodine, two preceding and one following operation, and the part protected by a sterile dressing, Bovee has secured negative cultures from scrapings taken fifteen days after operation

It occurred to Robb<sup>5</sup> that negative cultures obtained from skin still coated with iodine possibly would not prove that the solution was germicidal since even a small amount of that chemical in a culture medium might inhibit the growth of organisms If bacteria live in spite of the iodine some are apt to be carried into the peritoneal cavity and there, freed of their iodine, go on to dangerous development

In experiments conducted upon 21 patients when the iodine was present upon the skin 96.4 per cent of cultures were sterile After removal of the iodine 57.6 per cent remained negative

Further experiments were made with bacteria growing in vitro Fifty per cent iodine tincture, added to growing cultures, and allowed to remain during incubation stopped growth When, in other experiments, the iodine was washed out in sterile water after acting for two minutes, abundant growths were obtained

Robb concludes that there is still no certain method of sterilizing the skin, that tincture of iodine in all probability possesses a definite inhibitory action upon the growth of bacteria, and that sterilization with tincture of iodine is not to be relied upon, and should be used only when more elaborate forms of sterilization are contra-indicated

Seelig and Gould<sup>6</sup> consider previous methods of testing germicides faulty as they were carried out under artificial conditions

A germicidal solution cannot be thoroughly effectual unless it possesses the power of penetration in order to attack resistant bacteria in the deeper tissues This power of penetration is the process known as osmosis

Seelig and Gould tested the ability of various germicides, in watery solution, to pass through a colloidin membrane and destroy bacteria Iodine alone possessed this property The experiments with alcohol were surprising Alcohol in the highest strengths penetrated to the bacteria and killed them very quickly, the greater the percentage strength the quicker the action Experiments with alcoholic solutions of antiseptics demonstrated that, with the exception of iodine, the unadulterated alcohol acted as rapidly and efficiently as did the alcoholic solutions of germicides Harrington's solution was no more efficient than its 60 per cent alcohol content An alcoholic solution of iodine killed the bacteria more quickly than did the highest strengths of alcohol alone

Although these experiments were highly suggestive Seelig and Gould wished, if possible, to more closely simulate clinical conditions. They therefore utilized animal membranes. The method of procedure was as follows. A small salt-cellar was filled with the germicidal solution to be tested and then a flap of skin (still alive and attached to the animal) was laid over the salt-cellar in such a fashion as to pouch into the fluid. Into the pouch, which was bathed on one side (the outer surface of the skin) by the fluid to be tested, was put a measured quantity of a broth culture of bacteria. Live mesentery and live omentum were also used.

The results obtained were quite comparable to those secured in the experiments with the colloidin membrane. Alcohol penetrated and was effectual as a germicide in direct proportion to its percentage strength. It even penetrated the hide-like skin of the rabbit. Tincture of iodine penetrated and killed even more rapidly than did strong alcohol. Quite unexpectedly carbolic acid in 5 per cent solution quickly penetrated an animal membrane although the same strength solution had failed to pass through colloidin. It should have been foreseen, however, in view of the fact that watery solutions of carbolic acid may readily be recovered in the urine after extensive skin applications of this drug.

"That washing the skin with water swells the epidermis, thus imprisoning the bacteria, or that the water softens the epidermis so that it desquamates and easily brushes off during operative manipulations, or that the excess of water dilutes the alcohol used subsequently," are reasons suggested to account for the fact that iodine and alcohol are most efficient on a dry skin. None of these, however, is correct, according to Seelig and Gould. Repeating the experiment of Lheimite<sup>7</sup> they found that by rubbing the rabbit's skin with castor oil the alcohol penetrated much more quickly. Seelig and Gould conclude that a preliminary washing of the skin, which removes its natural oiliness, decreases the osmotic power of iodine and alcohol, and that this alone is the reason for the use of these chemicals on the dry skin.

Keilty and Packer<sup>8</sup> conducted a series of laboratory tests for the purpose of determining the relative inhibitory and germicidal power and diffusibility of various antiseptics, and their most effective strength. The phenol group and thymol gave the best results although tincture of iodine 3 to 10 per cent and mercuric iodide 10 to 30 per cent were markedly active. Alcohol seemed inert. Keilty and Packer state that their results are merely experimental and must be borne out by clinical application. They note the possibility of toxic effects from the phenols.

Whiting and Slocum believe that perfect asepsis of the skin is not essential to primary union, and that conservation of the natural resistive and recuperative powers of the tissues is an important measure of prophylaxis of wound infection. Laboratory and clinical findings should be correlated. The germicidal power of various antiseptics should be compared with carbolic acid or phenol as a standard according to the Rideal-Walker coefficient test. Scrapings from the skin are imbedded in culture media and incubated.

Whiting and Slocum investigated various so-called phenols (coal-tar disinfectants) of high coefficient but less corrosive and less poisonous than carbolic acid

In their clinical tests the operative field was wet-shaved and the patient was given a warm tub bath the night before operation. On the day of operation without further preparation, scrapings from the skin were taken and cultured. All showed growth of staphylococci. The part was rubbed for two minutes with gauze saturated with the solution to be tested. The solution was washed off with sterile water or allowed to evaporate. Cultures made from scrapings were all sterile. Out of 446 tests made one half hour later, to show whether or not bacteria had been brought from the deeper layers of the skin, contamination occurred in 37 instances and a growth of staphylococci appeared in one tube. Cultures from strips of skin showed numerous growths, due chiefly to contaminations by non-pathogenic bacteria.

Laboratory tests convinced Whiting and Slocum that acetone has no germicidal power. Alcohol, in strengths varying from 40 to 50 per cent destroyed the bacillus typhosus in less than two and one-half minutes. Acetone 40 parts, and alcohol 60 parts, also destroyed the bacillus typhosus in less than two and one-half minutes. Acetone 40 parts, alcohol 60, and liq cresolis comp 2 parts gave the same results. Various other coal-tar products with acetone, and alcohol in strengths varying from 60 to 65 per cent all destroyed the bacillus typhosus in less than two and one-half minutes. None of the proprietary preparations possessed as high a phenol coefficient as was claimed by the manufacturer.

Whiting and Slocum conclude that none of the various solutions used will destroy all germs of the skin in all instances, but that a solution consisting of acetone, alcohol and one of the coal-tar disinfectants of a high phenol coefficient is more efficient than any other agent we have ever used for skin sterilization. The acetone is solvent of the fats and oils. The alcohol is solvent and germicidal. The acetone and alcohol prepare the way for the powerful germicidal action of the coal-tar disinfectant.

In regard to the clinical use, which might, perhaps, be termed "test" of iodine, much could be said. Robb states that Grossich<sup>9</sup> has an undoubted claim to priority in advising its use on the dry skin, although Major Woodbury, U S A,<sup>10</sup> had utilized the tincture of iodine for skin preparation in 1906. Wollheim,<sup>11</sup> also, has found evidence in the literature that Cannaday, in 1906, and Dannreuther, in 1908, had made use of it upon the skin previous to the paper of Grossich.

Stretton<sup>12</sup> voices his supreme confidence in the efficacy of iodine with the statement that its use has been satisfactory to him in over 3000 cases, without preliminary scrub, no matter how dirty the skin may appear, nor shave, except the hair be very long. He makes an application of two and one-half per cent tincture of iodine B P and two and one-half per cent potassium iodide one-half hour before operation, another on the table, and a third over the incision after sewing up.

Lambert<sup>13</sup> conducted a series of experiments to determine the comparative effects of various antiseptics upon human tissue cells growing in vitro, and upon bacteria

“In the case of the majority of the chemicals used (potassium cyanide, phenol, tricresol, hydrogen dioxide, and alcohol) tissue cells were definitely more easily killed than were bacteria

“Iodine stands out as the one chemical treated to which cells were found to be more resistant than were staphylococci. A growth of cells were seen after exposure to a 1-2000 solution of iodine for one hour, a strength sufficient to sterilize the tissue completely in most instances

“These experiments afford further experimental evidence of the value of iodine as an antiseptic, and indicate that, at least in weak aqueous solution, it should not, as is often stated, injure or irritate the tissues. It was observed, however, that iodine has the property of rapidly dissolving fibrin, a property which, theoretically, should not be conducive to wound healing. A similar action by hypochlorites (Dakin's solution) was also noted”

(During a visit to the Mayo clinic in 1914 the writer saw Dr. Judd swab the walls of the incision with iodine after removing a malignant tumor from the bladder. Judd stated that this practice had not seemed to interfere with union.)

Lambert concludes that “The comparative resistance of bacteria and human tissue cells to antiseptics and other chemicals may be easily tested by tissue cultures under conditions which approximate those found in the living body

“A comparative study shows that while human cells (connective tissue and wandering cells) are highly resistant to many antiseptics, they are in general more easily killed than bacteria (*staphylococcus aureus*)

“Of the antiseptics tested, which include mercuric chloride, iodine, potassium mercuric iodide, phenol, tricresol, hydrogen peroxide, hypochlorites (Dakin's solution), argyrol, and alcohol, the one which approaches most closely the ideal disinfectant is iodine, which kills bacteria in strengths that do not seriously injure connective tissue cells or wandering cells”

In the prophylaxis of infection we must consider, according to Bond,<sup>14</sup> the inhibitory action of strong antiseptics upon the normal activity of the phagocytes

Bond learned that a cotton thread boiled in water containing powdered indigo in suspension laid in aseptic wounds untreated with strong antiseptics was almost decolorized in forty-eight hours. In wounds treated with strong antiseptics, mercuric chloride 1-1000, or carbolic acid 1-20, the thread showed some delay in decolorization. Control experiments with salt solutions gave normal reactions

Investigation has convinced Bond that “The fact that phagocytes are constantly transporting organisms from the cavity or the surface to the tissues which form the walls of a wound means that any adverse influence acting on these loaded cells on their return journey calculated to interfere

with their power of retaining and digesting these ingested organisms is a source of danger. It is possibly in this way that antiseptic solutions act prejudicially when used too continuously or in a too concentrated form." That there is a return emigration of wandering cells from a wound is demonstrated by Bond by powdering granulations with indigo and finding, on section, evidences of pigment remote from the surface.

In a series of 10 cases the writer has made investigation of the scalpel with which the skin incision was made, by means of stab cultures. There were no growths of pus-producing bacteria although several contaminations occurred. These tests prove nothing as regards skin sterility but are at least suggestive that the use of two scalpels in making the incision is probably unnecessary.

Concerning the use of rubber gloves Morris<sup>15</sup> considers that rapid operating through small incisions by sense of touch without gloves is essential in emergency surgery such as operations for perforated gastric, duodenal, or typhoid ulcer, or in dissecting out firmly adherent structures as a pyosalpinx or an appendix. Morris believes that large incisions and tedious technic allow bacteria to enter the wound from the air. Men who wear gloves are apt to be careless in the preparation of their hands. From personal observation Morris states that he has no more infection from operating with bare hands than do other surgeons who wear gloves while operating in the same hospital. Those who habitually use thick gloves never develop that finer sense of touch which the older generation of surgeons possesses. He concludes, however, that the modern thin glove is less objectionable.

Jonas<sup>16</sup> quotes O Wandel and O Hoehne to the effect that rubber gloves smeared with cultures of streptococci and staphylococci, or with pus of the same origin and allowed to dry for twenty-four hours, could, in many instances, be sterilized by a vigorous scrubbing with green soap and water for two and one-half minutes.

Brewer,<sup>17</sup> who has made numerous studies of aseptic technic, notes that infections prolong the hospital stay, work hardship upon the patient, and increase the hospital burden.

He traces the decrease in wound infections in the City Hospital from 39 per cent in 1895, to 3.2 per cent in 1900. This improvement was brought about by the installation and intelligent use of adequate sterilizing apparatus, many changes in technic, the use of a dilute solution of formaldehyde for wound disinfection and dressings, and the employment of sterile rubber gloves. The only accurate gauge of the number of infections, and hence the opportunity of improving individual aseptic technic, is dependent upon careful records of infections. Brewer states that the air of the operating room was constantly contaminated by pus-producing germs, as demonstrated by agar cultures. It became necessary to cover the instruments etc., with sterile coverings and to irrigate the wounds. This state of affairs does not exist, of course, in hospitals treating patients from the higher walks of life whose living conditions are better.

Brewer relates that early in his service at the Roosevelt Hospital an epidemic of infection occurred. There were five cases in one day and several on the succeeding few days. Cultures were taken from gloves, gowns, caps, towels, sheets, sponges, instruments, ligature and suture material. The latter showed growth, and when the stock of contaminated gut was destroyed the epidemic of infection ended. Two cases of infection with the bacillus aerogenes capsulatus occurred within a few days. The source of the bacilli was not found but the investigation revealed a defect in the steam sterilizers.

Brewer inaugurated a weekly report of each patient operated upon and every infection was investigated. During the first six months of 1912, six out of two hundred and fifty clean cases became infected, a percentage of 2.4 per cent. Not being satisfied with this result the staff surgeons censored each other's operations, carefully observing details. This investigation showed "That the suture and reserve instrument tables were too near the operating table, and that the towels covering these were not infrequently contaminated by orderlies and instrument nurses while bringing in the patient, handling hand lights, or the cautery apparatus." Other possible errors in technic were noted resulting in a rearrangement of the operating room furniture, having the patient placed upon the operating table, prepared and draped in another room, and other changes. The report for the ensuing six months revealed only 1.2 per cent of infection in 234 clean cases. The adoption of long sleeved gowns seems to have been an improvement. Investigation showed that three cases which developed infections near together were operated upon under local anæsthesia. The novocaine solution, which had been prepared in the drug department, was found to be contaminated.

*Summary*—Analysis of the several investigations herein quoted is extremely instructive. For example

Whiting and Slocum state that alcohol, 40 to 95 per cent, will kill the bacillus typhosus in practically the same time as various coal-tar derivatives in alcoholic solutions of from 60 to 65 per cent. Nevertheless, they consider the phenols to be more efficient germicides.

Post and Nicoll learned that mercuric chloride has very little germicidal action in aqueous solutions.

Whiting believes that alcoholic solutions of mercuric chloride are much more efficient, especially on dry skin.

Grossich emphasizes the importance of using alcoholic solutions of iodine on a dry skin.

Of alcohol Whiting says "As a solvent or vehicle for the various antiseptics used on the skin, it is vastly superior to water, the alcoholic solutions penetrating more deeply and having greater germicidal power than the aqueous."

Keilty and Packer conclude that alcohol is practically inactive as a germicide.



Post and Nicoll rank alcohol, in solutions of more than 50 per cent, as one of the most active germicides

Comment Some investigators have underestimated the germicidal power of alcohol

Bovee's tests of the skin, leaving the iodine on, gave negative cultures fifteen days after operation

Robb believes that the action of iodine is merely inhibitory and he fears peritoneal invasion by unkilld germs during operation

Robb and Whiting both obtained sterile cultures before neutralization of the antiseptic but a large percentage of growths occurred after neutralization

Post and Nicoll also consider tests of doubtful value unless the action of the antiseptic is stopped forthwith

Comment Clinically, iodine is allowed to remain upon the skin. It penetrates into the deeper layers, and we have no means of determining how long its activity may continue. The consensus of opinion classes iodine as an effective germicide. Granting that its action may be delayed, or that perfect asepsis of the skin is unattainable, or assuming, with Robb, that iodine merely inhibits germ life, nevertheless, the tissues, including the peritoneum, can defend themselves against limited numbers of bacteria

Morris enumerates the disadvantages of rubber gloves

Comment The fact that hand sterilization is so difficult and glove sterilization so easy would seem to outweigh the objections to the use of the latter

Seelig and Gould are convinced that laboratory tests which do not simulate clinical conditions are of little value, that alcohol in solutions of 50 per cent or more is strongly germicidal but less so than iodine, that a solution of alcohol and iodine together is more germicidal than either alone, that alcohol, carbolic acid, and iodine can penetrate animal membranes, and that penetration is facilitated by the presence of oil in the skin

Lambert has shown that iodine, alone, of various tested antiseptics, will kill bacteria rather than tissue cells

Comment Although the phenols have decided germicidal powers, and possess the ability of penetrating animal membranes, they are, unfortunately, tissue destroyers. Clinically, alcohol is non-irritating

Brewer demonstrated that infection may be due to minor lapses in technic, to germ-bearing suture material, to contaminated novocaine solution, or to failure of the steam sterilizer

Comment It is not safe to assume that any link in the chain of technic is unbreakable

#### CONCLUSIONS

1 Abundant clinical evidence of the efficacy of iodine in skin sterilization has been corroborated by laboratory findings

2 The germicidal action of mercuric chloride is too slow to be of value in sterilization of the skin

3 Eternal vigilance is the price of asepsis

# ASEPSIS AND ANTISEPSIS

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# TRANSACTIONS OF THE NEW YORK SURGICAL SOCIETY

*Stated Meeting, held April 25, 1917*

The President, DR CHARLES N DOWD, in the chair

## CARCINOMA OF RECTUM ABDOMINOSACRAL OPERATION

DR FRANZ TOREK said that, as there had been shown before this Society, on previous occasions, a number of cases of combined abdominosacral operations with the establishment of an artificial anus, he wanted to present a case in which the lower end of the sigmoid was implanted in the anus, not in the abdomen, thus giving the patient a natural, instead of a preternatural, anus

The patient was a woman, about forty-three years old, who had come under his observation suffering from pain in the rectum, constipation, and pain radiating down on the posterior surface of the left thigh Rectal examination revealed the presence of a crater-shaped ulcer with thick edges, about  $1\frac{1}{2}$  inches in diameter, situated on the left wall of the rectum, about  $\frac{3}{4}$  inch above the upper edge of the sphincter, or about 2 inches above the anus

On November 15, 1916, an amputation of the rectum by the combined abdominosacral route was performed The first step was the exploration A median incision was made from the pubes upward, and the patient was placed in Trendelenburg's posture The tumor of the rectum was felt in the location described before It did not seem to infiltrate the surrounding tissues, but there were numerous para- and post-rectal enlarged lymphatic nodes There were no metastases found in the liver nor in other parts of the abdomen

The next thing was the mobilization of the sigmoid, which in the operation he was describing formed the most important step In those methods of operating in which the sigmoid is implanted abdominally, a special technic of mobilization is not essential, but in this operation the correct mobilization of the sigmoid, performed in such manner as not to endanger its blood supply, is really the main thing of the whole operation, being often of vital significance

As a rule, the lower part of the sigmoid flexure is suspended from the inferior mesenteric artery and its prolongation, the superior hemorrhoidal artery, in such manner that it cannot be drawn down to the anus unless that blood channel is divided in some part of its course It was divided in the course of the inferior mesenteric artery, some distance above the point

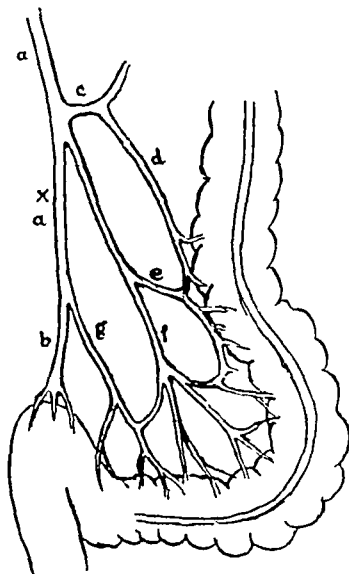


FIG 1 —Schematic drawing of the blood supply of the lower colon. *a*, inferior mesenteric artery, *b*, its terminal branch, or continuation, the superior hemorrhoidal artery, *c*, left colic artery, *d*, its descending branch, *e*, *f*, *g*, the first, second, and third sigmoid arteries, *x*, point where the inferior mesenteric artery is to be divided. This diagram shows the lower sigmoid to be suspended from the inferior mesenteric and superior hemorrhoidal arteries in such manner that it could not be brought down to the anus without division of this suspending cord in some part of its course. It also shows that, while the sigmoid arteries, *e*, *f*, *g*, anastomose freely among themselves and upward, there is no collateral circulation between the lowest sigmoid artery, *g*, and the superior hemorrhoidal artery, *b*. Therefore, the site for dividing the inferior mesenteric-superior hemorrhoidal blood channel is not in the superior hemorrhoidal section of it, as, owing to the absence of collateral circulation from the lowest sigmoid artery, the part supplied by the superior hemorrhoidal would be insufficiently nourished and hence would probably undergo necrosis. The proper place at which to divide the vessel is in the inferior mesenteric artery, a little above the place where the lowest sigmoid artery is given off. Then the blood from the upper sigmoid arteries can pass up through the lowest sigmoid, *g*, and down again through the superior hemorrhoidal artery, *b*.



where the lowest sigmoid artery is given off. The selection of this point for division of the vessel is of the greatest importance, as the maintenance of an uninterrupted communication between the lowest sigmoid artery and the superior hemorrhoidal artery is absolutely essential for the establishment of collateral circulation between the upper sigmoid vessels and the superior hemorrhoidal artery, as the branches of the latter vessel are, in the true sense, terminal arteries, and its ramifications have no collateral circulation. If, on the other hand, the mobilization were accomplished by dividing the vessel below the origin of the last sigmoid artery, the lower sigmoid and pelvic colon would have their blood supply shut off (compare Fig 1)

To find the inferior mesenteric-superior hemorrhoidal trunk—it is in reality one trunk, simply changing its name where the lower sigmoid is given off—the sigmoid flexure is drawn to the left and slightly downward. Then, as a rule, the mesosigmoid will give everywhere except where the above-named channel runs through, and, in consequence, that part of the mesosigmoid will become tense and will stand out in the form of a fold of peritoneum extending to the promontory of the sacrum.

The point of origin of the lowest sigmoid artery was called by Sudeck the “critical point” in his description of the blood supply of the rectum in its bearing on operative surgery. This point lies 1 or 2 cm below the insertion of the peritoneal fold, just described, at the promontory. The artery, if found, is tied about 2 cm above the promontory. Its accompanying vein can usually be readily recognized by its blue color. If it cannot be recognized, the mesosigmoid is tied above the promontory, at the height of the fifth lumbar vertebra, and divided. In the further course of the mobilization one should keep as far away from the gut as possible.

From the point of ligation the two layers of the peritoneum forming the mesosigmoid were cut downward in a direction parallel to the pelvic colon, on either side of which and of the rectum the incisions extended down to Douglas’ pouch, where they were united by a curved incision anterior to the rectum. The limbs of the sigmoid flexure were unfolded by radiary incisions of the mesosigmoid, care being taken not to injure the marginal arcades.

Now the pelvic colon and rectum were freed by blunt dissection with the hand, starting at the point of ligature and incision of the mesosigmoid, keeping close to the surface of the promontory, as far away from the intestine as possible, into the depth of the small pelvis. Thus the whole pelvic mesocolon with its glands remained in connection with the gut. This procedure was bloodless. Some arteries, probably the medial and lateral sacral, were tied before being divided. The separation of the rectum from the uterus was not difficult. Then the lateral strands were divided. In this manner the rectum was liberated down to the levator ani. The loosened intestine was now pushed well down into the pelvis, and the two edges of the divided mesosigmoid and of the peritoneum farther down were

sutured to the upper sigmoid in its new, lower position The abdomen was now closed

The patient then was placed in the right Sims position The buttocks and the anal, coccygeal, and sacral regions were sterilized An incision from the posterior margin of the anus to the lower part of the sacrum was made The coccyx was freed from the soft parts covering it and resected

The rectum in its lower part was now separated bluntly from the vagina and the adjacent areolar tissue A large loop of gut, consisting of rectum, pelvic colon, and part of the sigmoid, could now be pulled out of the wound A piece of gauze was passed under it, and with the use of traction on the lowest part of the rectum this was separated from the sphincter muscle, the dissection being partly blunt, partly sharp, so that now the rectum was attached below only at the mucocutaneous border of the anus

The anus was now stretched wide by an assistant, whereupon the rectum was pushed out through the anus, and the tumor with it, by a process of invagination Up to this point the operation was an entirely aseptic one The wound above the anus was now protected by gauze, and the operation proceeded with from the anal end

The tumor now protruded outside of the anus, being situated at the apex of a double tube, the outer layer of which was the anal portion of the rectum turned inside out, *i e*, its mucous surface on the outside This outer tube was now cut close to the mucocutaneous junction, leaving a cuff less than half an inch long Now the inner tube could be drawn out further, to any desired point At  $2\frac{1}{2}$  inches above the tumor a silk ligature was tied around the gut This was amputated below the ligature and the end cauterized with a Paquelin

Gloves were now changed At a distance of three-fourths inch above the cut end the gut was sutured to the anal cuff with interrupted silk sutures The silk ligature around the gut was now cut The attachment of the gut to the anal margin so as to let it protrude a short distance was chosen in order to allow for a certain amount of subsequent retraction The further course, however, showed that such retraction did not occur The sacral cavity was packed with iodoform gauze, and the wound was partly closed

The duration of the operation was two hours and five minutes, in the course of which an intravenous infusion of 600 c c with 15 minims of adrenalin was given

The patient was kept constipated for six days, during which time she felt quite uncomfortable Then an ounce of castor oil was administered, after which her condition was satisfactory

Twenty days after the operation the small protruding end of gut was cut off and the freshened end sutured to the skin

The patient ran a normal, afebrile course throughout and was discharged from the hospital on December 16, four weeks and three days after the operation

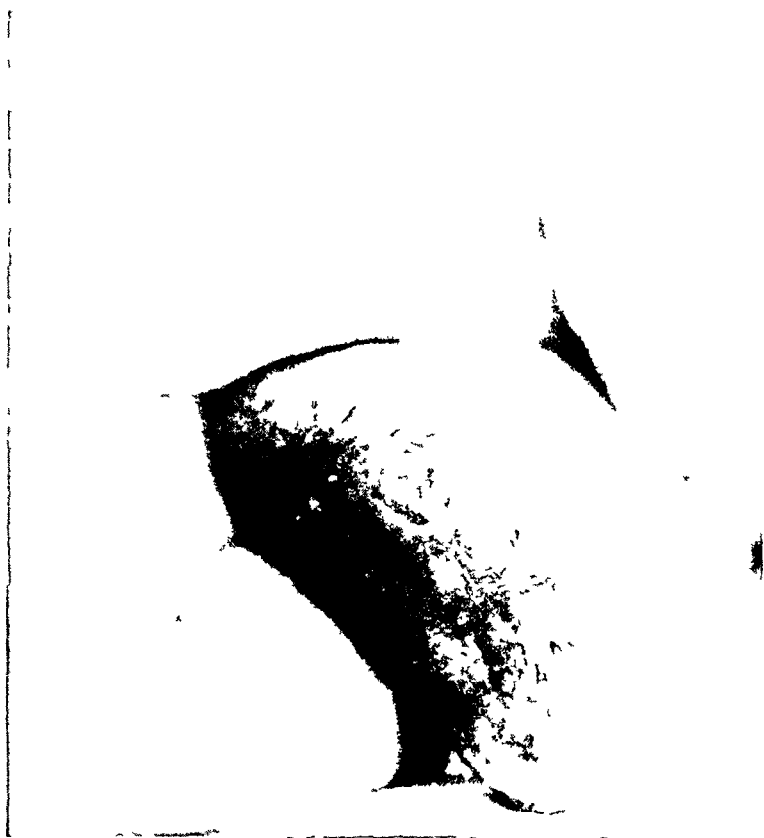


FIG 2 —This fails to represent the real size of the prolapse, as it was taken with the patient lying down, in which position nearly half of it slipped back





She has a normally functioning sphincter and has one movement a day, usually after an enema. Just above the anal margin, corresponding to the union of gut and skin, there is a stricture which is now being dilated.

The pathological diagnosis was: Carcinoma of the rectum with metastases in the lymph-nodes

DR HOWARD LILIENTHAL said that about ten days ago he operated for the extirpation of a constricting carcinoma of the rectosigmoid. After mobilizing the sigmoid and upper rectum through a left paramedian incision, a minute puncture in the sigmoid about six inches above the growth was made, and through this puncture the blunt end of a large probe was inserted and pushed on until it appeared at the anus. Through the eye of the probe, still within the abdomen, there was threaded a piece of tape, and this tape was tied firmly around the mobilized sigmoid. An assistant now withdrew the probe from the anus until the tape could be grasped, and then on firm traction an anal prolapse of the rectosigmoid was produced, bearing with it the carcinoma. The patient was now placed in the lithotomy position and the tumor-bearing gut was resected, anastomosis with two layers of sutures was effected and the parts returned to the abdomen by pushing them back through the anus. The abdominal wound was closed by suture with gauze and rubber dam drainage.

The packing was removed to-day and there has not been a single drop of leakage.

NOTE—At the present editing, four weeks after this operation, the patient is entirely well and has been discharged from the hospital.

DR WM T LUSK said that he had found that there often was a good sized artery running alongside the terminal portion of the sigmoid flexure, which joined the superior hemorrhoidal and sigmoid circulations, giving ample blood supply at this situation. However, Archibald of Montreal had injected these two circulations separately and demonstrated an area of poor vascularization where they met.

## PROLAPSE OF RECTUM OF EXCEPTIONAL SIZE ABDOMINAL OPERATION AND SPHINCTER PLASTIC

DR TOREK presented a man forty-eight years of age. He said that the photograph of the case (Fig 2) did not really represent the correct size of the prolapse, as the picture, contrary to instructions, was taken in the recumbent position in which the protrusion was nearly half reduced.

The patient was admitted to the German Hospital on March 28, 1916. Forty years ago he had been operated for an abscess of the hip-joint, after which operation a number of fistulæ persisted. Two years later he was operated for a rectal fistula. Afterwards it was found that the fistulæ of the hip and the rectal fistula communicated. About this time his thigh was amputated at the hip-joint, but in spite of this a number of sinuses persisted, requiring fifteen more operations. Following the last operation on the hip the rectal fistula recurred, and an operation extensively dividing the

sphincter was done, which resulted, four years ago, in the production of a prolapse of the rectum, which gradually increased in size up to more than six inches in length

On admission to the hospital the condition was one of a highly congested prolapse of the rectum over six inches in length, which was described by the house surgeon as having the shape of a large sized banana. Besides being intensely red it also presented some superficial abrasions and bled very easily on handling it. It was reducible only in the recumbent posture, but did not remain reduced even in that position, it would at once protrude again a little more than half the original volume, about to the extent shown in the photograph. The patient, who now looks the picture of health, was quite anæmic at that time, which was a little over a year ago, doubtless owing to the loss of small amounts of blood continued over a long period of time.

The anal opening was very large, consisting almost entirely of scar tissue. Only at one point, covering less than one-eighth of the circumference of the anal opening, could the remnants of the sphincter with its covering of wrinkled skin be seen.

The patient was kept in bed for two weeks preceding the operation in order to reduce as much as possible the congestion of the prolapsed part. On April 11, 1916, the abdominal part of the operation was performed—median incision from pubes almost to umbilicus, Trendelenburg's posture. The rectum was seen to have developed a very long mesorectum. This was incised on both sides and greatly shortened by suturing it over and on to the rectum after this had been drawn up to the utmost extent. The mesentery thus supported the rectum in its new higher position. The rectum was thus entirely covered by this additional layer of peritoneum. The pelvic colon was then sutured to the lateral abdominal wall with many silk sutures passed through peritoneum and fascia. The rectovesical pouch was obliterated by means of circular silk sutures. The appendix was found to be thickened and was removed with inversion of the stump.

Four weeks later, on May 9, the sphincter plastic was performed. The scar tissue was excised and the ends of the sphincter laid bare and sutured. This was not a very easy procedure. It did not heal by first intention, but the result, nevertheless, was such as to produce a satisfactory sphincteric action, and, in the year's time that has elapsed since the operation, the prolapse has not returned.

#### THE TREATMENT OF STAPHYLOCOCCUS SEPTICÆMIA BY TRANSFUSION OF IMMUNE BLOOD

DR RANSOM S. HOOKER read a paper with the above title, for which see page 513.

#### PLASTIC FLAP FROM ABDOMEN FOR BURN OF HAND

DR CLARENCE A. MCWILLIAMS presented a man of twenty-one years of age who was admitted August 4, 1916, for cicatricial contractures of



FIG 3 —Case II

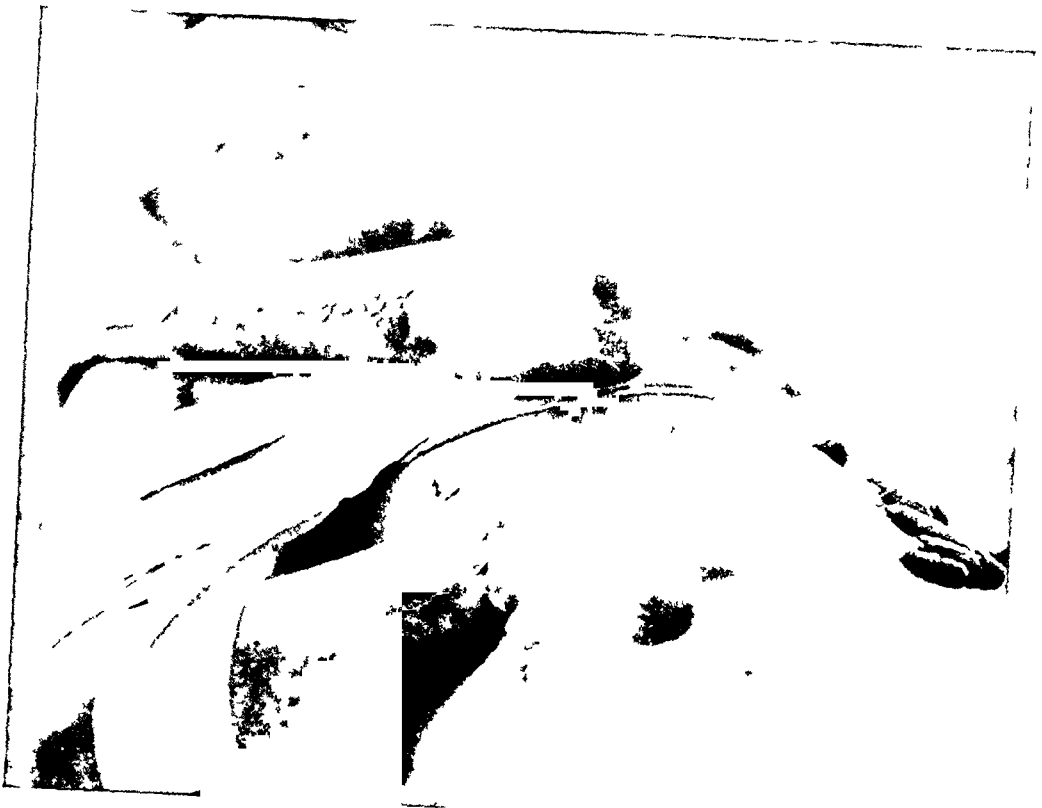


FIG. 4 —Case II



FIG 5 —Case II



FIG 6 —Case II



FIG 7 —Case II

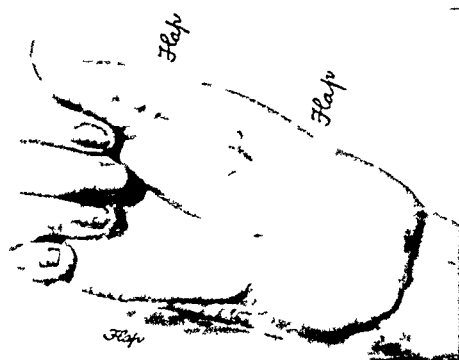


FIG 8 —Case II

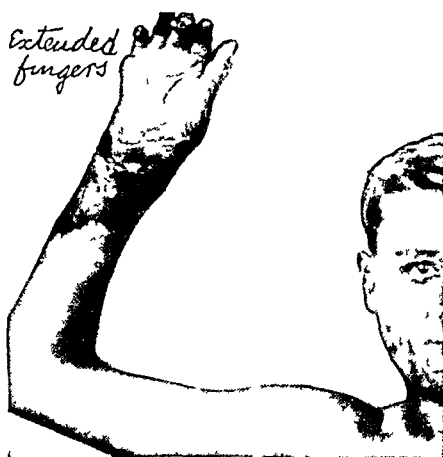


FIG 9 —Case II

## PLASTIC FLAP FROM ABDOMEN FOR BURN OF HAND

back of hands and wrists Eight months previously he had been severely burned in an explosion in a sugar factory Was in a hospital for four months, where apparently no effort was made to skin graft his hands, resulting in thick keloid scars on the backs of both hands, the right being much the worse (Fig. 3) The palms were not affected, but the scar in the right involved the bases of all the fingers, the entire back of the hand and wrist and the anterior aspect of the wrist for three inches The fingers could be flexed only one quarter the normal extent The three innermost fingers were bent backward at the metacarpophalangeal articulation The scars reach to the second phalangeal joints It was decided to replace this scar tissue by skin taken from the abdomen pedunculated The first operation was performed August 4, 1916 (Figs 4 and 5) The entire scar from back of hand and wrist and from the front of the wrist was excised *in toto*, a tourniquet being applied about arm It was a quarter of an inch thick and was peeled off the tendons in the back of the hand without opening the tendon sheaths to any extent The fingers could then be easily flexed The hand was laid on the abdomen (Figs 4 and 5) above the navel A vertical incision was made to the right of the navel and carried down to the muscle through the fat about five inches long The fat was separated from the muscles the whole vertical extent of this flap and sufficiently far over to the left to cover the whole raw area Were he to do this operation over again, he should not leave such a thickness of fat on the flap since the final result shows that the flap is too thick. The hand was inserted beneath this flap and small incisions were made through the flap corresponding to the positions where the finger bases would come through The fingers were drawn through these openings, there being left a bridge of healthy, undivided skin between each finger The entire raw surface edges were united with interrupted finest silkworm-gut sutures Two goitre rubber drainage tubes were inserted above and below the wrist at point of union to evacuate the oozed blood The arm was bound to the chest with plaster-of-Paris splint which was removed in three days and the arm held to the side (Fig. 4) with adhesive plaster The wounds remained clean, though there was considerable bloody discharge from the angles The second operation was performed on the fifteenth day after the primary operation It was decided not to divide at this time the lower pedicle but to cover in the raw area on the front of the wrist by turning the hand over on this pedicle and reflecting over on to the raw area on the front of the wrist (the palm being uninvolved) a continuation upwards of the skin flap from the chest (Figs 6 and 7) The flap from above was marked out one-third larger than the area to be covered and it was freed The hand was then turned over and the flap was fitted into the raw area on the front of the wrist where it was sewn on the sides The flap bled very freely, showing its blood supply to be ample Prior to turning the hand, however, the undivided bridges of skin between the fingers had to be divided and the edges were sutured The upper part of the defect on the chest was

extensively undermined and brought together with silkworm-gut, and Thiersch grafts were taken from the thigh to cover the remainder of the wound. These were covered by rubber mesh which he has found to be the best dressing for skin grafts.

The wound remained clean. The third operation, consisting in the division of half the transverse diameter of the lower pedicle, was performed on the twenty-first day after the first operation and six days after the second operation and the final division of the pedicle or fourth operation was made on the twenty-eighth day after the first operation and on the seventh day after the third operation. The blood supply of the flap was very profuse, the oozing being very free. The remaining raw area on the abdomen was covered with Thiersch grafts and several of these grafts were put in to cover small areas in some of the finger-webs.

The final result is shown in Figs 8 and 9. The finger flexion has become perfect. There was no necrosis of any of the flap. Sensation has returned in the flap to about one-quarter of its extent.

#### RESECTION OF FEMORAL VEIN FOR THROMBOPHILIA

DR WILLY MEYER said that it seemed to him necessary, first to give an explanation regarding the wording of the title of this presentation. Personally he believed the disease which Dr Buerger of New York termed thrombo-angitis obliterans to be not one of the blood-vessels but of the blood itself. He therefore had called it "thrombophilia," in contradistinction to hæmophilia. He is of the opinion that the trouble is likely dependent upon a disease of the glands of internal secretion. What Dr Buerger had explained as inflammation of the blood-vessel wall he considered to be not the primary but the secondary phenomenon.

Thrombophilia is a very mysterious disease. Not much is known about it. It occurs almost exclusively in men. Hæmophilia also occurs almost exclusively in men. Should the cause of the disease be found, conservative surgery would be feasible and the multiple amputations for gangrenous portions of the extremities, due to this cause, be avoided. So far quite a number of conservative methods of treatment have been tried, but none has given permanent satisfaction.

Of late the speaker had tried ligation of the femoral vein in seven patients. In two of these the vein was resected for the sake of immediate microscopic examination of a fresh specimen by the pathologist. One of these two patients is present. He is 34 years old and came to the hospital in a carriage, he couldn't walk more than one block. He had great pain. There was no pulse in either of the tibial arteries. The operation was somewhat complicated on account of the many branches that enter the femoral vein in just this particular region. Quite some hemorrhage was encountered, at last the proximal end of the vessel had to be tied just below Poupart's ligament. The wound healed kindly. To-day, four months after the operation, the patient is much improved, is able to walk eight to ten blocks, has much less pain, can sleep in bed.

## OLD DEPRESSED FRACTURE OF SKULL

The operation is done with the intention of retaining more blood in the extremity and to let the tissues have the benefit of this greater quantity of blood as long as possible. The explanation of the effect of the operation is simple in comparing the lower extremity with a washbasin which has a small influx and a wide outflow. In letting the water run in, the basin will be continually empty. If we now decrease the size of the outflow and have the same amount of water running in, it will soon begin to fill.

There are three places in Scarpa's triangle where the vein can be tied at the top of the triangle, above the entrance of the deep femoral vein, and above the entrance of the saphenous vein.

Dr Meyer prefers to tie the vessel at the base of the triangle, right below Poupart's ligament. The blood has then to return through the posterior (principally gluteal) veins and the internal iliac vein, and must of necessity have the greatest impediment to return.

The operation is never to be done in the presence of gangrene, as conditions get worse after it.

It seems that the operation is deserving of further trial.

He had under observation one patient who illustrates the late result of an arteriovenous anastomosis done for thrombophilia four years ago. He appears in perfect health to-day, although his original trouble is not cured. It is to be regretted that the patient is out of town. In the future more will be heard of arteriovenous anastomosis for the symptomatic treatment of this trouble.

## OLD DEPRESSED FRACTURE OF THE SKULL, JACKSONIAN EPILEPSY, BRAIN CYST, CRANIOTOMY WITH FAT TRANSPLANTATION

DR MEYER presented a lad, eighteen years old, who was hit, when in his seventh year, by a man whom he was watching split wood with an axe. He sustained a compound depressed fracture of the left parietal bone with great injury of the brain. He was brought to a nearby hospital, where he stayed for a few months, his wound healing slowly.

He slowly developed spasmodic contraction of the right hand and also partially of the toes of the right foot, and in the last months before his admission to the German Hospital, Jacksonian epilepsy. The question was whether one could possibly help such a patient with a surgical interference so many years after the injury. At the operation the scars were excised and the depressed bone exposed, a few holes were bored into the skull and cut through with a Gigli saw. A part of the bone was then carefully removed. When lifting out the bone a large amount of clear fluid suddenly escaped. A brain cyst had been opened, the wall of which was partially formed by portions of the formerly torn dura mater. Excision of this wall was done and the adhesions of dura and skull all around thoroughly loosened with the finger.

In order to provide against reformation of adhesions of the brain to



the skull, a fat transplantation from the abdominal wall was added. The transplant surrounded the defect of the dura mater in all directions. The wound was then sutured and closed without drainage.

The patient made a good recovery. There is now a small opening due to a partial necrosis of the bone at one point which was divided by the saw. So far the epileptic attacks which he had before the operation have not returned.

#### DUODENAL ULCER SUBHEPATIC ABSCESS DRAINAGE THROUGH PERTHES' INCISION

DR MEYER presented a man who was operated upon three months ago. He had had signs of duodenal ulcer, and two days before admission to the hospital had a sudden sharp pain in the right hypogastrium, also in his right shoulder and in the median line between the xiphoid, followed by fever.

Analysis of the duodenal contents showed normal bile and pancreatic juice. Yet it seemed that the gall-bladder had to be accused as the cause of the acute trouble.

After a number of days of further analysis and observation Perthes' incision was made, the advantages of which have been seen by the speaker in quite a number of cases. By means of a rectangular incision, dividing the rectus muscle transversely, a skin muscle flap is turned up, thus saving the intercostal nerves that enter the rectus muscle. Then the second incision is made in front of and parallel with the costal arch, giving a most beautiful access to the upper abdomen. In this case this incision was selected in order to be prepared for all emergencies. The omentum, it was found, had been drawn towards the liver. On loosening it a large amount of foul pus was suddenly discharged from below the liver. The gall-bladder was found way down beneath the liver at the posterior aspect of the peritoneal cavity lying in a horizontal direction, it was somewhat changed in its shape, but contained no stones. There was no reason to puncture or to remove it. In the patient's precarious condition such was considered to be a wrong procedure. A distinct infiltration was palpable at the posterior aspect of the duodenum close to, but distal from, the pylorus. Culture of the pus showed streptococcus.

The abscess cavity was thoroughly drained and the greater part of the two incisions closed by sutures, the drains' exit being at the upper angle of the wound. The space beneath the skin muscle flap was also drained.

The patient made a good recovery, duodenal feeding being commenced two days after the operation. To-day he is perfectly well. His abdominal wall is perfectly solid.

#### RIGHT BRONCHIECTASIS, LIGATION OF THE BRANCH OF THE PULMONARY ARTERY FOR THE LOWER LOBE OF THE RIGHT LUNG

DR MEYER presented this case because the speaker believed that in this present time of the evolution of thoracic surgery the result of a rather con-

## PNEUMOTOMY FOR BRONCHIECTASIS

servative operation appears to be of some interest. The operation was performed four years ago, in February, 1913. The patient, who was then twenty-two years old, was very much annoyed by frequent expectorations of a large amount of very foul mucopus, which made it impossible for him to stay at work.

At the time ligation of the branch of the pulmonary artery had just been proposed by Sauerbruch for the treatment of bronchiectasis. The lung, deprived of its physiological work by the ligation of the vessel, becomes solidified and adherent to the chest wall. After this thoracoplasty is added and the lung permanently compressed.

This was the third case operated upon in this way by the speaker, the patients recovering nicely from the operation. This operation was done in the negative chamber under regional novocaine-adrenaline anaesthesia. Details of this case were published in the ANNALS OF SURGERY a few years ago. To-day the patient is in good condition. His expectoration has become reduced from 350 to 400 cm. permanently to 15 to 30 cm. in twenty-four hours.

## PNEUMOTOMY FOR BRONCHIECTASIS

DR MEYER presented a man thirty-two years old, who came under his care in January of this year. Five months before he had passed through a severe attack of pneumonia, in the wake of which continuous expectoration of foul-smelling mucopus followed. Clinical examination, radiography and bronchoscopy pointed to an affection of the left lower lobe and to bronchiectasis rather than to a larger cavity formation (abscess). Under intratracheal insufflation anaesthesia an incision was made in the seventh intercostal space surrounding the lower half of the scapula. The free pleural cavity was entered, but farther back towards the spine the lung was tightly adherent to the chest. Because of the trouble being present for four months only, and the lung not showing the brown discoloration as is usually seen in cases of advanced bronchiectasis, it was decided not to do lobectomy but pneumotomy.

With the adherent lung in view aspiration was done, the needle being passed first through the undivided portion of the intercostal muscles. Pus was found. In view of the fact that the free pleural cavity was opened, the needle of the aspirator could not be left in place to be the guide for opening the abscess. It had to be withdrawn, the point of entrance being compressed by a gauze tampon.

Now a drainage tube, slipped through a hole in the centre of a round piece of cork, was placed in the pleural cavity, air-tight, under the guidance of the operator's eyes, in one of the lower intercostal spaces (Kenyon's method) and the opened portion of the free pleural cavity closed. When the needle was now put back in the same place of the adherent lung, where pus had first been found, the latter was not struck. However, a larger amount of air was aspirated into the well-working record-syringe. The

aspiration of air from the lung tissue is in cases of bronchiectasis just as important as that of pus. The cavity containing the pus simply was temporarily empty.

With the needle in place the cavity was then successfully incised with Paquelin's thermocautery. It was not very large but easily admitted two phalanges of the forefinger. It was distinctly seen to be irregular, clearly a part of the bronchial system. It was thoroughly drained with split rubber tubes and iodoform gauze and the dressing applied. After the patient had been returned to his bed the outer end of the drainage tube in the pleural cavity was connected with a bottle placed under the bed, the same dipping into a bichloride solution. Immediately air bubbles appeared in great numbers, proving that the lung expanded.

The patient had stood the operation nicely. On the second day his condition suddenly became very alarming, being due, it seemed, to the advent of an infectious pleurisy. However, because of the infected effusion developing having an outlet through the drainage tube the patient got over it nicely. Three days later his temperature was normal again. He was out of bed in the course of two weeks after the operation. At present he is back at work with his wound almost closed.<sup>1</sup>

#### RESECTION OF THE CHEST WALL FOR ENDOTHELIOMA, ILLUSTRATING KENYON'S THORACIC DRAINAGE

The last case presented by DR MEYER was a woman fifty-one years old, in whom a hard sessile tumor was palpable below the right breast, corresponding to the mammary-pectoral skin fold. Under intratracheal insufflation and with the help of a large semilunar skin incision, the chest wall was exposed and then the tumor, with about 15 to 20 cm length of four ribs, totally excised. After ligation of the feeding vessels the skin flap was carefully sutured back in place. Here, too, thoracic drainage was employed as described before, and the same smooth convalescence observed. After 48 hours, secretion from the pleural cavity had practically ceased.

Of course it cannot be said that the patient might not have made the same good and quick recovery without the drainage. However, there can be no doubt that the latter had been a very great point in favor of a quick recovery.

The speaker considers this kind of drainage to mean a tremendous advance in thoracic surgery. He will likely not operate a single case of primary thoracotomy any more, entering a non-infected pleural cavity, except using this drainage.

A few years ago the speaker had worked out at the German Hospital another method of free drainage of the pleural cavity after thoracotomy by leaving the patient under differential pressure for fifteen to twenty hours following the operation. But this method is cumbersome. It requires the permanent attendance of two nurses. Kenyon's method appears to be a

## FIBROMA OF ILEUM WITH INTUSSUSCEPTION

safe and simple procedure. It fulfils not only Sauerbruch's postulatam of air-tight closure of the chest after primary thoracotomy, but at the same time drains off the usually large amount of secretion which follows our work within the healthy pleural cavity in most cases

*Stated Meeting, held May 9, 1917*

The President, DR CHARLES N DOWD, in the chair

### FIBROMA OF THE ILEUM WITH INTUSSUSCEPTION

DR FREDERIC KAMMERER presented a man, fifty-nine years of age, who, in September, 1915, began to suffer from intermittent colicky pains in the abdomen, of mild character. These gradually increased in severity. He was under observation for several weeks at the hospital when his illness began, where, with the exception of slight tenderness in the region of the descending colon, palpation revealed nothing. The X-ray examination was also negative. He has been suffering for the past one and a half years from indigestion, loss of appetite, flatulency and not very severe paroxysmal attacks of pain in the abdomen. He is not constipated and has never vomited. He was readmitted to the hospital in April, 1917, in a much run-down and rather anæmic condition. He has lost over 80 pounds in weight. During the first few days of observation nothing abnormal could be felt within the abdomen, but on the day preceding operation a mass about six inches long was detected in the left lower quadrant. There was no distention present, but on manipulation of the abdomen slight visible peristalsis could be noticed. The X-ray picture was inconclusive. On opening the abdomen an intussusception was easily found in the lower ileum, ending about eight inches from the ileocæcal valve. The same was about eight inches in length, the tip of the intussusception being a globular, elongated mass. By expression and traction we were able to reduce the intussusception to the extent of several inches, but further attempts were not made, as the lymph-glands in the mesentery, corresponding to this section of the intestine, were very large and presented a hard, nodular appearance. On the assumption that we were dealing with a malignant tumor, an extended resection of the mesentery was done, necessitating the removal of three and one-half feet of the small intestine. The proximal end of the bowel was closed and its distal end, situated two inches from the cæcum, was implanted, end to side, into the former. The patient made an uneventful recovery. From the pathologist's report (Dr Humphreys, of the German Hospital) he quoted the following: The lumen of the distal 15 cm of the resected ileum is occupied by a large pear-shaped tumor mass, approximately 10 cm in length by 6 cm in diameter at its widest part. The greater bulk of the tumor, including its wider end, lies free within the lumen of the intestine. The smaller end comprises the pedicle by which it is attached to the wall of the

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<sup>1</sup> At time of correcting report the wound is closed

gut The mucosa covering the pedicle is eroded and ulcerated but not deeply so The surface of the globular tumor is also fairly smooth, but discloses over it numerous small circumscribed nodules a few mm in diameter, of somewhat firmer consistence than the rest of the tumor The wider portion of the tumor is elsewhere covered by a fairly smooth appearing mucous membrane, the narrow portion by an ulcerated and eroded one In the mesentery are found several enlarged masses, evidently enlarged lymph-nodes One of these is about the size of an egg *Anatomical diagnosis* Pedunculated fibroma of the intestine with intussusception and inflammatory œdema in mesenteric lymph-nodes Among the benign tumors of the small intestine pure fibromata appear to be rather uncommon, lipomata, adenoma and myomata being more frequently encountered When such things give rise to an intussusception they generally lie at the apex of the invagination, and in the vast majority of cases the intussusception is responsible for the clinical symptoms, tumor having existed for some time and escaped detection In our case, no doubt, the final invagination was of the acute variety, as a tumor was found only on the day preceding operation This, of course, does not signify that former attacks of colic were not accompanied by invagination and later spontaneous reduction At the operation no adhesions were found between the two layers of the intussusception, which fact also supports the view that the invagination was of recent occurrence

As to the resection of three and one-half feet of intestine, fortunately followed by recovery of the patient, it is but fair to say that it later proved to have been an unnecessary procedure The more radical operation was done on the assumption of malignancy The large nodular lymph-nodes and the cachectic look of the patient seemed to justify this view The appearance of the tumor itself was rather against it In a number of cases of sarcoma of the small intestine reported in the literature of the subject metastatic glands are spoken of in the mesentery, but of a microscopical examination of the lymph-nodes no special mention is made In a number of these, as in his own, the glands may also have been simply of an inflammatory nature

DR ELLSWORTH ELIOT said that this case presented several unusual features In the first place, the loss in weight of eighty pounds is something that, in a review of the cases reported in the article to which Dr Kammerer has referred, was rarely if ever mentioned

Then, it is also of interest because of the glands involved Again, if his recollection served him correctly, he found no instance of glandular involvement as a result of infection from the surface of benign growths The benign growths themselves were rarely ulcerated The mucous membrane in these cases was always intact It is interesting to note that tumors in the small intestines, with or without intussusception, are almost invariably benign, while those in the large intestines are in about three-fifths of the cases malignant

## FIBROMA OF ILEUM WITH INTUSSUSCEPTION

Dr. Eliot had seen only one case of carcinoma in the small intestine. This was situated within six inches of the ileocecal valve, and was resected. The patient died four months later of metastasis of the liver.

Cases of carcinoma in the small intestine, with or without intussusception, are very malignant, much more so, in fact, than malignant tumors in the large intestines. Dr. Kammerer's case perhaps corresponds with one which was reported in the paper referred to, in which the symptoms simulated those due to an obstruction by fecal impaction. The mass extended from the neighborhood of the splenic flexure across the transverse colon and down the ascending colon. This mass disappeared after a high oil enema and yet with no substantial discharge of gas and fecal material. Shortly after the tumor reappeared and during the following fortnight it presented the typical features of a chronic intermittent intussusception.

After three weeks, the condition was complicated by chronic bronchitis and emphysema. On operation a tumor of the same character as that reported by Dr. Kammerer was found in the lower part of the ileum. When intussusception had taken place it had passed through the ileocecal valve into the ascending colon and around the hepatic flexure into the transverse colon. From this rather advanced position it had receded from time to time in the manner described, without any material symptoms. At the time of the operation the tumor of comparatively small size was easily reducible until the ileocecal valve was reached, through which it was reduced with some difficulty. The final part of the intussusception could not be reduced, and required resection. I believe this to be, without question, the appropriate treatment in these cases.

The second case that was reported in the paper referred to emphasized the point that the clinical features in these cases of intussusception vary very widely. It was one of the most stormy cases of acute intestinal obstruction that he had ever seen. The patient was brought to the hospital in the middle of the night with intense abdominal pain and bloody stools. The abdomen was distended and the coil of intussuscepted intestine could be distinctly felt on either side of the abdomen. Immediately operation was done and an intussusception two feet in length was found. Even the slightest reduction was impossible and the entire mass was resected.

Both patients, fortunately, recovered. The technic differed from that employed by Dr. Kammerer in that the continuity of the intestine was restored by end-to-end anastomosis.

There are also cases that are not due to tumor, and perhaps it is just as well to refer to them, because of their acute character. He referred to intussusception associated with a Meckel's diverticulum. In the preparation of the paper referred to by Dr. Kammerer, he found in the literature 10 or 12 cases of acute intussusception of the ileum in patients of from fifteen to twenty. These cases were all cases of acute irreducible intussusception.

DR. JOHN F. CONNORS said that in July of last year there was admitted

to his service at Harlem Hospital a case with the diagnosis of acute appendicitis, who, after being kept under observation for twenty-four hours, developed signs of intestinal obstruction. At operation there was found an intussusception about two feet from the ileocaecal valve. When this was reduced it contained a hard mass about the size of an egg, which reduced the lumen of the gut about two-thirds its normal size. About twelve inches of intestine was resected, followed by end-to-end anastomosis, a single enlarged gland was removed from the mesentery. The pathological report showed the tumor and gland to be a round-celled sarcoma. After operation the patient's weight rose from 90 to 135 pounds. In February of this year he returned to the hospital, complaining of the same pain in his abdomen. After being in the hospital for forty-eight hours he again developed signs of obstruction. At the second operation another intussusception was found about three feet from the first one which was exactly like the one found seven months previously. He had besides this two other tumors of equal size about one foot from the intussusception. About three feet of intestine were removed, containing the masses, and a lateral anastomosis was done.

At the second operation all the mesentery was found filled with glands, the tumors and glands proved to be round-celled sarcoma. After this operation he picked up and is still doing very well.

DR DEWITT STETTEN said that he reported on the submucous lipoma of the gastro-intestinal tract some eight years ago, in connection with a rather unique case that was sent to the hospital with the diagnosis of prolapse of the rectum. On examination, the patient presented at the anus a pedunculated, mucous membrane covered mass that suggested a polyp of the sigmoid. It was impossible to feel the end of the pedicle, but it certainly was not a prolapse of the rectum. It looked very much more like a polyp of the sigmoid or descending colon, and with that diagnosis he operated on the patient. He found the mass to be a chronic ileocaecal intussusception due to a large lobulated, polypoid submucous lipoma of the ileum which had travelled through the entire large intestine. A Maunsell resection and anastomosis were done, and the patient made an uneventful recovery.

He was present at Kammerer's operation and he would also like to emphasize the difficulty in making the diagnosis as to the character of the tumor. To all appearances, at the time of the operation, this was a malignant tumor. He examined the specimen immediately after it was removed, although he did not open the gut. Even then he had very little suspicion that it was a benign tumor, particularly when he looked at the mesenteric glands. He even incised one of the larger glands and it seemed to show malignant infiltration.

#### FOUR KINDS OF APPENDICITIS

DR ROBERT T MORRIS read a paper with the above title, for which see page 560

# TRANSACTIONS

## OF THE

### PHILADELPHIA ACADEMY OF SURGERY

*Stated Meeting, held May 7, 1917*

The President, Dr. CHARLES H. FRAZIER, in the Chair

#### SPLENECTOMY FOR PERNICIOUS ANÆMIA

DR J STEWART RODMAN reported the history of a man, aged thirty-nine years, who was admitted to Dr Sailer's service August 13, 1916, suffering from asthenia. He had been well until five weeks before admission when he began to have daily attacks of abdominal pain, with chills and sweats, and an attack of vomiting every other day. No blood in the vomitus nor in the stools. Lost weight rapidly—thirty pounds during the period. He was markedly pale and anæmic, eyes prominent, skin icteroid, tender under right costal margin, spleen not palpable, no adenopathy—urine albuminous but free from casts and sugar, on admission red blood-corpuscles were 2,580,000, hæmoglobin, 30 per cent. Two weeks later the red count had fallen to 1,050,000 with hæmoglobin 20 per cent. A blood transfusion of 150 c c was done September 17, which raised the red count to 3,420,000, with hæmoglobin 30 per cent. October 18, the red count had fallen to 3,100,000 with hæmoglobin 35 per cent. A splenectomy was resorted to October 19, being done by Drs Allen and Rodman.

The removed spleen was one and one-half times its normal size, was adherent to stomach, pancreas, colon and diaphragm. Moderate hemorrhage. Pedicle clamped and double ligated. Gauze packing to diaphragmatic surface. The gauze was removed five days later. The postoperative course was uneventful. On October 24, five days after the removal of the spleen, the red count had risen to 3,250,000, hæmoglobin 44 per cent, three weeks later the red count had risen to the normal level of 4,470,000 with hæmoglobin 45 per cent. The patient was discharged home November 15, 1916.

#### GUNSHOT WOUND OF THE SPINAL CORD

DR J STEWART RODMAN reported the history of a man aged thirty-four years, who was admitted to the Presbyterian Hospital, in the service of Dr F O Allen, December 17, 1916, on account of a gunshot wound of the neck.

The bullet had entered posteriorly on the right side at the base of the neck. He was unconscious when admitted but regained consciousness shortly after admission. Temperature 100 degrees. Pulse 80. Complete paralysis of upper and lower limbs. Loss of sensation to upper third of chest. Loss of bladder and rectal control. An X-ray plate showed a bullet in the spinal cord about the level of the fifth cervical vertebra.



*Operation*—(Gas and oxygen) Drs J S Rodman and F O Allen

Laminectomy, spines and laminae of fifth, sixth, and seventh vertebrae removed. Fourth and fifth vertebrae fractured by bullet, 38 caliber bullet removed from spinal canal at level of fourth cervical vertebra. After lifting bullet from its bed it was seen that the spinal cord was completely divided at this level, wound closed with gauze drainage.

#### TRAUMATIC BRACHIAL PARALYSIS

DR ASTLEY P C ASHHURST presented a man, aged fifty-four years, who was referred by Dr J H Baldwin to his service at the Orthopaedic Hospital, June 10, 1916. On March, 1916, this man had fallen and injured his left shoulder. One week after the injury the man applied to Dr Baldwin, who sent him to the Methodist Hospital. Paralysis was present at this time. Dr Baldwin found the whole limb much swollen, and recognized the presence of an unreduced dislocation of the shoulder (subcoracoid), this was reduced at the hospital under primary anaesthesia by Dr L J Hammond. The patient went home eight days after the dislocation was reduced, in good condition. Two weeks after leaving the hospital he says his arm began to swell, he had considerable constant pain like pins and needles radiating from the shoulder to the fingers. He then returned to the Methodist Hospital, where he remained six weeks, receiving massage and electricity.

*Examination*, June 10, 1916, three months after the injury, when first seen at the Orthopaedic Hospital, showed a healthy looking man, with the left upper extremity hanging helpless at the side of the body. There was no *voluntary motion* below the shoulder except very slight power in the triceps, sufficient merely to extend the elbow a trifle, and very questionable power of pronating the forearm. The arm could be elevated from the side by means of the trapezius acting on the scapula. There was good power in the pectoralis major. There was noticeable atrophy of the deltoid. There was no power to flex the elbow, nor to move the hand or fingers. The hand was slightly swollen. *Passive motion* at the shoulder external rotation was limited at the sagittal plane, abduction at 35 to 40 degrees (without causing rotation of the scapula), other passive movements were normal except slight loss of full extension of the elbow. There was some grating in the shoulder on motion, and some thickening of the bones.

*Electrical examination* by Dr H P Boyer, June 12, 1916, showed reaction of degeneration in the deltoid, biceps, triceps and the flexors and extensors of the carpus and fingers. The response was very poor to the galvanic current, and there was practically no response at all to the faradic current.

*Treatment* consisted in massage and electricity three times weekly. The question of exploratory operation was discussed with the patient, but not urged very enthusiastically, and was not accepted by him.

July 1, 1916. The elbow and hand swell at times. He thinks he has more power in the shoulder and elbow, but none is apparent on examination.

September 16, 1916 The patient says that sensation, which was absent below the elbow when he first came to the hospital three months ago, has returned very gradually and now is about normal from the wrist up In the hand hypæsthesia (no anæsthesia) persists The patient was seen at this time by Dr Francis W Sinkler, who believes the lesion to have been a laceration of the nerves in the axilla Examination to-day (September 16) shows no power to flex the elbow, though the biceps can be felt to contract voluntarily, there is doubtful voluntary power in the brachialis anticus, but he is unable to flex the elbow even when the forearm is hanging vertical like a pendulum with the arm held horizontal There is fair power in the triceps The elbow cannot be fully extended passively He is able to abduct his shoulder to about half the normal extent, and the deltoid can be felt contracting There is almost normal active flexion and extension of the shoulder There is good pronation and weaker supination of the forearm, the latter being accomplished mainly by the biceps, which can be felt to contract though it is not strong enough to flex the elbow

September 25, 1916 *Electrical examination* by Dr Boyer shows no change from that of June 12, except that the deltoid no longer shows reaction of degeneration

April 14, 1917 The patient, who still comes three times weekly for massage and electrical treatments, says that up to about two months ago he could not feel hot water in the hand, he could put it in "boiling water" he says, and not know it Now, however, sensation is normal *Active motion* shoulder can be abducted to 60 degrees, the deltoid seems normally active, flexion and extension of the shoulder are almost normal, internal and external rotation are good, but the latter is limited at the sagittal plane Flexion and extension of the elbow are good, but flexion is still a little weak Flexion of the wrist is *very* weak, but there is fair power of extension There is full supination, and pronation to the mid-position, both of fair strength There is very little movement in the fingers, consisting only in very feeble flexion and extension, there is no power to separate the fingers The thumb can be moved slightly in flexion and extension *Passive motions* at the shoulder there is no more passive than there is active motion At the elbow the range of passive motion is from 60 to 160 degrees Rotation in the forearm is normal The wrist extends almost normally, flexes two-thirds normal. The fingers and thumb can be flexed half the normal extent, and can be fully extended.

May 4, 1917 *Electrical examination* by Dr H P Boyer There is marked improvement shown The deltoid, biceps, triceps, and extensors of fingers do not show reaction of degeneration, and respond fairly well to the Faradic current The flexors of the fingers still show reaction of degeneration and do not respond to the Faradic current

Dr Ashhurst added that he thought the diagnosis in this patient was correctly given by Dr Sinkler as a laceration of the nerves in the axilla The laceration probably was slight, consisting rather in stretching than any

actual solution of continuity The effusion of blood, lymph, and synovial fluid no doubt also was in some measure responsible for the disability The prognosis probably is good in this case for ultimate recovery even of the hand, though when the patient was first seen, and especially when it was found that reactions of degeneration were so complete, there seemed little hope of ultimate recovery

Dr Ashhurst recalled that Duval and Quillain (1898) maintained that all nerve lesions accompanying injuries by indirect violence at the shoulder were either *radicular* or *terminal*, there being no such clinical entities as ruptures of the brachial plexus Also that Delbet and Cauchoid (1910) had collected 36 cases of paralyses, complicating dislocations of the shoulder 25 were *terminal*, and were caused by the dislocation, 11 were *radicular*, and were caused *not* by the dislocation, but by the same cause which produced the dislocation In this series there were no lesions of the brachial plexus proper

The present case, therefore, supports these investigations

DR T TURNER THOMAS said that it has long been the tendency to attribute all traumatic brachial paralyses of a diffuse character to injuries of the brachial plexus because a nerve rupture involving so many muscles could not be located anywhere else The late results, according to his experience, show that almost every case recovers completely from the paralysis The sensation is rarely disturbed seriously, and in almost every case the shoulder-joint is stiff and painful, indicating that it was injured

For six years he had been trying to show that the paralyses in most of these cases is secondary to the shoulder-joint injury and disappears with the complete recovery from this joint injury, sometimes before The greatest difficulty is in deciding what cases may properly be included under the traumatic brachial paralyses Some surgeons believe that the Duchenne-Erb paralysis (C V, and C VI) is common in adults and serious, while most surgeons ignore it entirely in their practice, and it is given no place in surgical text-books Yet few surgeons, probably, would deny that traumatic brachial palsy of varying degree from injury in the shoulder region is frequent but rarely permanent The fact of the matter is that discussion of the subject is being avoided

He recognized two main classes of these cases In the first, by far the most common, the shoulder-joint becomes stiff and painful, but is in no sense flail These recover completely with the restoration of normal function in the shoulder-joint or even in the presence of a considerable permanent ankylosis In the second the causal force dropped a half inch or inch below its normal level under the acromion, and later the joint became flail when the pain and muscle rigidity disappeared, and especially when the resulting atrophy became marked Early removal of the flail condition of the joint and then of motion, the operative stiffness is followed by a complete cure In other words, the operation puts the joint into the condition found in the first class, which is then overcome

Not infrequently there will be found in both groups, from the shoulder

to the ends of the fingers, marked pain and tenderness in all of the structures, with pain and stiffness in all of the joints, much worse in the hand than elsewhere. This condition is present in Dr Ashhurst's case and is now the only condition to be reckoned with. It is not peculiar to shoulder injuries. LeBreton has reported a series of cases following Colles's fracture. In all of his cases with flail shoulder, four in number, except the first seen five years ago, there was more or less swelling in the hand, extending a variable distance upward. It may have been present in his first case before he saw it, nearly five weeks after the accident. He had had at least as many cases without flail shoulder. He doubted if a patient with a marked case of this condition can ever again have a normal hand, because adhesions have developed between all of the tendons and their sheaths, in addition to the trouble in the joints, and he could not believe that the adhesions would disappear and the tendons work freely in their sheaths again.

## CANCER OF THE PENIS

DR B A THOMAS reported the history of a man, aged thirty-seven years, who was admitted to the Polyclinic Hospital on January 4, 1917, with the following history. He had had a phimosis all his life, and had never been able to retract the prepuce. One year ago he noticed a slight discharge from the penis, but did not pay any attention to it at the time. The condition grew worse for a while, and a few months later the glans penis began to recede from the margins of the prepuce, and to swell at the same time. There has been a bloody discharge from the ulcerated area for most of the time during the past year. At the time of admission the end of the penis presented a huge cauliflower growth, which, together with the oedematous loose connective tissue, measured about four inches in diameter. The growth apparently had its origin in the region of the coronal sulcus on the dorsal aspect of the organ, but at the present time by contiguity has involved three-fourths of the circumference of the infiltrated organ, merely a portion of the glans in the region of the meatus being free. The inguinal lymph-nodes on both sides were palpable. The Wassermann reaction resulted negatively.

On January 5th patient underwent operation, consisting of bilateral inguinal lymphadenectomy and total extirpation of the penis, the incision extending downward from both inguinal regions, meeting and encircling the root of the penis, thence downward, dividing the scrotum to the middle of the perineum, after which the corpora cavernosa were freed from their attachments to the ramus of the ischium. The bulb of the penis was then divided, the urethra severed and anastomosed in the perineum at the lower angle of the incision, after which the wound was closed. The histopathological report stated growth to be a squamous-celled carcinoma of the penis, with very early metastasis to the inguinal lymph-nodes.

A few days after the operation, X-ray treatment was begun as follows. For three days, each day, he was given six exposures of ten minutes each,

at different sites This was repeated in three weeks, and again in four weeks, the last treatment being given after he was discharged from the hospital, which was on February 5 The patient's convalescence was remarkable in the fact that a week after his discharge from the hospital he was employed as a chair-pusher on the boardwalk at Atlantic City Seen two months after he left the hospital, he was still at this occupation, experiencing no discomfort and had not any incontinence of urine, difficulty on urination, or evidence of contracture of his new external urinary orifice

### HYDROCELE OF EXTREME SIZE

DR THOMAS presented a man, aged seventy-three years, who was first seen on March 26, 1917, at the Surgical Out-patient Department of the University Hospital, complaining of a huge rupture He stated he had been the victim of herniæ on both sides for twenty years Eleven months ago he fell, striking his herniæ, after which swelling began on the left side, and increased rapidly At the present time the mass is so large that the patient is obliged to carry it in a hammock, suspended from his shoulders, by improvised suspenders The penis is almost lost to view, becoming invaginated in the tumor, and appears as an inconspicuous dimple on the right side The act of urination is accomplished by pressing a funnel against the skin below this dimple, which diverts the urine to a receptacle The tumor is cystic in character, and fluctuates, and seems to be about two-thirds fluid, transmitting light in the lower two-thirds This swelling, complicating the hernia on the left side, is remarkable chiefly because of its size, measuring 41 centimetres on its vertical diameter, and 81 centimetres in circumference The hydrocele was tapped, any other form of treatment being out of the question, and sixteen pints of fluid were removed

### MYOSITIS OSSIFICANS PROGRESSIVA

DR B A THOMAS and (by invitation) DR F G HARRISON presented a little girl, four years of age, with the history that about February, 1916, the mother noticed a lump in the child's back in the lumbo-thoracic region, which she says appeared after a fall while at play This grew larger, and other lumps appeared, and her neck became stiff She has grown progressively worse She has never complained of pain There is no history of any lumps disappearing There is limitation of motion of the spine, shoulders, and hips There is a loose body in the right axilla, the others are all immovable

There is an evening rise of temperature, no cough Wassermann is negative She plays around with other children

*Family History*—Father living and well Mother has pulmonary tuberculosis She has been deaf for seven years and has grown progressively worse lately Has had eight children, three dead of causes uncertain, four others, besides patient, well

*Previous Medical History of This Child*—Normal birth. The mother says there was a congenital malformation of the great toe, hallux valgus. The child was breast fed for three months. Had measles prior to her trouble, whooping cough when she fell, and chicken-pox afterward.

#### INDICATIONS AND TECHNIC FOR REMOVAL OF THE SPLEEN

A paper with the above title was presented by DRS GEORGE P. MULLER and CHARLES H. FRAZIER.

DR P. G. SKILLERN, JR., called attention to the very excellent method of controlling the blood-supply in splenectomy which the essayists did not mention, this was suggested by J. C. A. Gerster (*Jour Am Med Assoc*, August 7, 1915), who believes that ligation of the arterial supply of the spleen at certain points which are more accessible than the deeply situated pedicle will greatly facilitate difficult splenectomies. These points are (1) the splenic artery close to the celiac axis, (2) the gastro-epiploica sinistra where it reaches the stomach from the splenic. The celiac axis is readily exposed through the lesser omentum just above the lesser curvature of the stomach and border of the pancreas, and may be made to come within one inch or so of the anterior abdominal wall by hyperextending the spinal column as for gall-bladder operations. This method should be applicable in certain cases of Dr. Muller's Group I, namely, in certain cases of traumatic rupture of the spleen, especially those cases where there is already severe traumatic shock, to which the addition of the surgical shock attendant upon splenectomy might surpass the margin of safety and kill the patient, in these cases mere ligation of the splenic artery with, if thought necessary, stuffing of the great omentum in the splenic rent, should suffice to bring about the immediate recovery of the patient. In cases of removal of the spleen for disease, in which there are numerous vascular adhesions conveying a vicarious exotic circulation to the spleen, ligation at these two points would serve to diminish the hemorrhage, but not to control it entirely.

By ligating the splenic artery at its origin a "safety first" principle is observed, precautionary against hemorrhage due to unforeseen accidents during or after operation, thus, after mobilization and delivery of the spleen its pedicle might be found to be very short and hard to clamp and ligate, and Dr. Frazier mentioned the possibility of the ligature slipping off the pedicle—a catastrophe for which there is no excuse, and one which can be prevented by anchoring the pedicle ligatures with two or three additional small ligatures.

As to the incision, Dr. Muller stated that he employs a long, vertical cut through the left rectus. For upper abdominal work the transverse incision, advocated last year by Moschowitz, seems advantageous upon anatomic grounds. This incision divides one or both recti transversely two inches above the navel and is continued transversely outward through the flat muscles of the flank as far as conditions warrant. The advantages of this transverse incision are freer exposure and less damage to the abdominal

wall With the exception of the rectus the muscles and congeries of minute tendons into which they insert are cut parallel with their fibres, instead of at right angles, as with all vertical incisions, for the same reason, the motor nerves, too, escape division As regards dividing the rectus muscle transversely, the ultimate result is but the addition of another transverse cicatricial intersection to the three or more tendinous ones normally present The scar resulting from the wound is stronger and its cutaneous portion eventually almost invisible The transverse incision, however, takes more time, and when time is an important element, the linea alba incision, as advocated by Percy, could be employed

#### TRAUMATIC BRACHIAL PARALYSIS WITH FLAIL SHOULDER-JOINT

DR T TURNER THOMAS read a paper with the above title, for which see page 532

DR NATHANIEL GINSBURG said that he had observed and treated three cases of traumatic brachial paralysis in adults The first patient (Figs 1 and 2) was seen in July, 1912, and then presented a total paralysis of the shoulder girdle and arm, except for part of the supraspinatus and trapezius muscles The intercostal humeral nerve was intact There were marked trophic changes in the extremity, and he suffered from intense shooting pains in the forearm, hand, and fingers On January 13, 1912, the injured extremity was caught in a heavy leather machinery belt He remembered nothing of the injury until he awakened in the hospital, and was then told that his collar bone had been broken The extremity was bandaged to his side for three weeks, at the end of which time it was discovered that a severe nerve injury had taken place A careful dissection of his brachial plexus was made in the Polyclinic Hospital, and the cords were found totally disorganized and beyond operative repair

The second case (Figs 3 and 4) was observed in the Jewish Hospital in August, 1916 The patient was a fireman, twenty-three years of age, whose left shoulder and lower cervical region were struck by a locomotive running in the opposite direction while he was leaning out of the cab in which he was riding He suffered a traumatic avulsion of the cervical and brachial nerve trunks, resulting in total paralysis of the left upper extremity, with some sensation persisting corresponding to the distribution of the intercostal humeral nerve He also sustained a fracture of both bones of the forearm of this extremity near the wrist joint and a fracture of the neck of the scapula The inequality of his pupils at the time of his admission and also at the present time is marked Operation, seven weeks after the injury, exposing the left cervical and brachial plexus with division of the outer third of the clavicle revealed the presence of intraspinal avulsion of some of the cervical nerve trunks entering into the formation of the brachial plexus, with complete division of some of the lower trunks The dissociation of the cords entering into the formation of the brachial plexus was so marked and the perineuritic changes so extensive that it was not possible to satisfactorily make new

FIG 1

FIG 2

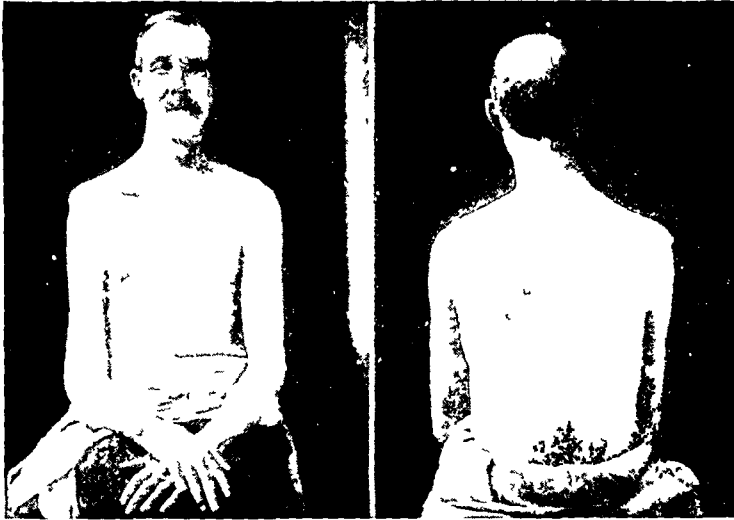


FIG 1 and 2 —W F B, aged forty-four years Traumatic rupture of brachial plexus Injury January 13, 1912 Extremity caught in heavy leather belt of machinery Remembered nothing until he awoke in the hospital, when he was told that his collar bone was broken, the arm being bandaged to the side for three weeks July 27, 1912 Total paralysis of the shoulder girdle and arm, except for part of the supraspinatus and trapezius, intercostohumeral nerve intact, trophic changes in the extremity and intense shooting pain in the hand and fingers Operation, July, 1912, disclosed rupture of the brachial plexus trunks

FIG 3

FIG 4



FIG 3 —C S, aged thirty-three years, fireman Traumatic avulsion of the brachial plexus Total paralysis of the left upper extremity with some sensation corresponding to the distribution of the intercostohumeral nerve Operation Partial anastomosis of intact cords No result attained

FIG 4 —Same patient as Fig 3 Lateral view, showing left upper extremity, following an injury to the cervical and brachial nerve trunks Fractures of both bones of the forearm near the wrist and fracture of the neck of the scapula, complicating the injury to the nerve trunks



FIG 5

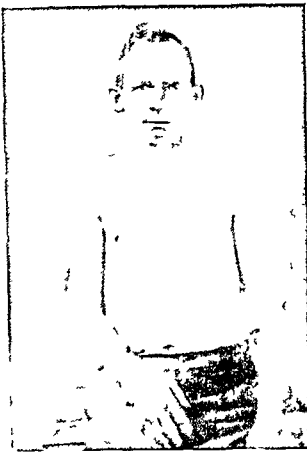


FIG 6

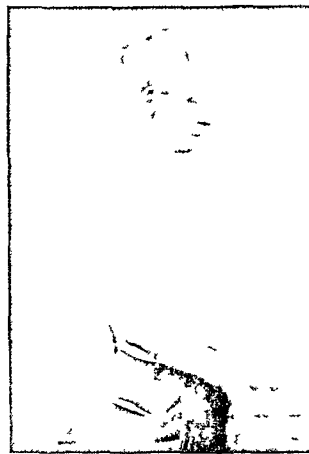


FIG 5 —C A C Traumatic brachial palsy of the right upper extremity as result of being struck by a controller in the supraclavicular region, with coincident partial fracture of the head of the humerus. Note the atrophy of the shoulder and right pectoral region with swelling of the extremity.

FIG 6 —Same patient as Fig 4. Lateral view. Note the suprascapular and deltoid and right pectoral atrophy. Some use of the muscles corresponding to the distribution of the median nerve is present. Marked involvement of the ulnar and musculospiral nerves. Decided improvement under massage and electricity.

nerve anastomosis, although a few of the trunks which seemed intact were brought together and sutured. The operation has apparently failed to restore any function in this extremity, for he seems to be hopelessly injured.

In both these cases the primary injury was apparently extreme traction exerted upon the cervical cords, plus direct trauma compressing the brachial plexus between the clavicle and the first rib.

The third patient (Figs 5 and 6) was seen through the courtesy of Dr Zion, of Wilmington. The man was injured in a street car altercation, being struck in the right supraclavicular region, and sustaining a partial fracture of the head of the humerus. A careful examination showed a paralysis typical of a traumatic brachial palsy, with some preservation of function corresponding to the motor and sensory distribution of the median nerve. The atrophy and the trophic changes, as shown in the photographs, are characteristic of paralysis of the type under discussion. He did not believe that there was division of all the nerve fibres in this case, but thought a considerable amount of his injury was the result of the trauma sustained by the controller which struck him in the supraclavicular region. With the application of massage and electricity, he has made considerable improvement, although the last examination a short time ago still shows extensive involvement of his musculospiral nerve.

He had been much interested in the surgical treatment of those cases where total division or extensive injury of the whole brachial plexus has taken place. On the cadaver he had found that it is anatomically impossible to successfully transplant cords from the opposite side, because the trunks are too short if carried across the pretracheal region, and also because the shortest route across the neck, which is prevertebral, would necessitate an extensive dissection and expose the patient to grave injury. Again, where there is extensive or complete involvement of the whole plexus on one side, it would not seem wise to jeopardize the integrity of the sound side by longitudinal splitting of the nerve trunks.

It had occurred to him that if the upper intercostal nerves could be transplanted across the axilla into the trunks of the injured nerves, this operation would be indicated, since the intercostal nerves carry both motor and sensory fibres. Cadaver attempts to perform this operation have shown that the chief difficulties are first the danger of opening the thoracic cavity, since longitudinal resection of a number of ribs must be practised, and secondarily the intercostals are of surprisingly small size, even as far posteriorly as it is possible to reach them by the transaxillary route. One of these patients was exceedingly anxious to have this operation attempted, but he could not bring himself to believe that it would be justifiable to expose him to the risks of such an extensive procedure. All of these patients have bitterly complained of the intense neuritic pain in their hands and fingers from which they constantly suffer, and two have requested amputation of the injured extremity.

Dr Ginsburg thought that Dr Thomas had a little different conception of traumatic brachial paralysis from that which is generally held. The cases

of traumatic brachial paralysis which appear in the literature largely consist of reports of serious injury to many or all of the cervical or brachial nerve trunks entering into the formation of this plexus. The term is generally employed to express a break in the continuity of the nerve trunks, either partial or total, the severance occurring intra- or extraspinally.

The cases reported by Bristow, Murphy, Frazier, and Skillern, as well as the three patients whose cases he had briefly presented, were instances of injury to the brachial cords, sustained as the result of trauma and confirmed by operative findings. The injury disclosed in this class of cases at the operating table has been one definite and severe injury to the nerve trunks, with coincident perineuritic changes. The class of cases reported by Dr. Thomas would suggest rather a primary shoulder injury without the brachial plexus participating to any great extent, or it may be that in a number of his cases the deltoid muscle has been partially or completely paralyzed by injury of the circumflex nerve, owing to its close proximity to the neck of the humerus. Certainly, relaxation of the capsule of the shoulder joint cannot occur in the absence of partial or complete paralysis of the deltoid muscle, and this at once implies injury to a nerve structure. The absence of operative investigation of the brachial plexus in most of his cases does not sustain the belief that they belong to the type generally termed traumatic brachial paralysis.

DR. PENN. G. SKILLERN, JR., remarked that Dr. Ginsburg, in his discussion of Dr. Thomas's paper, said that for the relief of cases of traumatic brachial paralysis where the spinal rootlets themselves were torn asunder, such as reported by Dr. Frazier and himself in 1911, he had conceived the idea of dividing the intercostal nerves and anastomosing their proximal ends with the distal portion of the brachial plexus. Such an anastomosis, even granting that it is practicable, would be but a drop in the bucket and quite like sending a lilliputian on a giant's job, as far as concerns making up the loss of the great number of motor fibres possessed by the brachial plexus, especially when one considers that the upper six intercostal nerves carry only enough motor fibres for the supply of the small intercostal muscles alone, how far would these few motor fibres go when it comes to innervating the great muscular masses which move the upper limb?

DR. T. T. THOMAS quite agreed with Dr. Ginsburg that there are two kinds of traumatic brachial paralyses. What he was trying to show is that there are a great many in which there is probably no injury to the brachial plexus. No one who heard or read Dr. Frazier's paper of 1910 or 1911 on this subject, with its detailed report of a case in which the spinal canal was opened and an intraspinal rupture found, could fail to believe that real ruptures take place. On looking up the paper of Madame Klumpke on traumatic brachial paralysis of the lower arm type, he was struck by the number of cases that she collected which, with the one she reported, were almost exact counterparts of the one reported by Dr. Frazier. This type shows absolute loss of sensation and motion and never recovers. The cases he had been reporting have recovered fully from the paralysis and never

## PARALYSIS OF BOTH TRAPEZII MUSCLES

had serious impairment of sensation. Moreover, they all had associated injury of the shoulder joint.

### PARALYSIS OF BOTH TRAPEZII MUSCLES AFTER ABLATION OF CERVICAL LYMPH-NODES, WITH PROPOSAL OF A NERVE-ANASTOMOSIS OPERATION FOR CURE

DR PENN G SKILLERN, JR, presented a man, aged eighteen years, referred by Dr Thomas Tigam, who was admitted to the Polyclinic Hospital (No 31152) on April 24, 1917, for removal of recurrent tuberculous cervical lymph-nodes. He was discharged, cured, on May 3, 1917.

He had been operated upon one year before elsewhere, for on each side there was an operative scar four inches long along the posterior border of the sternomastoid muscle—diseased nodes evidently having been removed from the occipital triangle, and the trapezius branch of each spinal accessory nerve had been resected, for both trapezii were paralyzed and atrophied, bringing to the surface the deep anatomy of the shoulder girdle and base of the neck (Fig 7). The patient stated that he noticed his shoulders drooping forward when he got up from bed after the operation.

The photograph shows beautifully the extent to which both shoulders droop forward. Both clavicles are prominent, and the supraclavicular fossæ are so deep that apical tuberculosis is suggested (Fig 8). The upper border of the scapula with its notch can be plainly felt just beneath the skin; the vertebral border can likewise be felt. The spine of the scapula and supraclavicular fossa are easily palpable. In other words, conditions are such as would be expected from a knowledge of the origin and insertion of the trapezius muscle, given the presence of atrophy of this muscle. The head, too, is inclined forward. The fresh operation incision was made by the author to remove recurrent tuberculosis of the lymph-nodes when the upper limb of this incision was made the scar from the previous operation was excised, so that the situation of the latter is indicated. It was necessary to divide the sternomastoid to reach enlarged nodes beneath its upper third; during this manoeuvre the sternal branch of the spinal accessory nerve was seen sinking into the sternomastoid muscle and was lifted up with the muscle without injury. The region of the old scar on the left side of the neck was not reoperated upon. The levator scapulæ muscles stand out prominently and subcutaneously on both sides. Loss of function of these muscles is well compensated.

A similar case was presented by Vosburgh before the New York Surgical Society on April 22, 1914 (ANNALS OF SURGERY, 1914, lx, 762). In the discussion which followed, Mathews said he had seen the spinal accessory nerve accidentally divided and the injury not followed by shoulder drop, and also when its division was necessary, neurorrhaphy could be performed with very good expectation of reunion. Dowd, referring to the relative importance of the spinal accessory nerve and the branches of the cervical plexus in the innervation of the trapezius muscle, stated that in a much used

method of removing tuberculous lymphnodes the branches of the cervical plexus (III and IV) are sacrificed and the spinal accessory alone is preserved, and that while in many instances this is sufficient to provide good innervation to the trapezius, in other instances it might not be sufficient. Eliot found in a number of instances the development of these nerves differed very materially. In some cases the terminal branch of the spinal accessory passing to the trapezius was exceptionally well developed, in others it was not developed so well, while in rare instances it was entirely absent. Eliot also found that with a weak spinal accessory supply, the branches of the cervical plexus supplying the trapezius were exceptionally well developed, and *vice versa*, this might be accounted for by variations in the anastomosis between the spinal accessory nerve and the cervical plexus. In those cases where the spinal accessory supply of the trapezius was well developed, the degree of anastomosis between the cervical plexus and the spinal accessory was not well marked.

Reporting two cases of operative paralysis of the spinal accessory nerve, Bailey (ANNALS OF SURGERY, 1901, xxxiii, 558) states that serious disturbances of motion in both sternomastoid and trapezius immediately following operation, which obtained in his patients, contradicts the more common experience, for in most cases the paralysis which results from section of the nerve is not particularly disabling. Large pieces of the nerve are resected for spasmodic wry-neck without fear of serious loss of motor power, and in only a few of the reports of accidental section is any mention made of paralytic results of consequence. This is explained by the additional supply to the trapezius from the cervical plexus. When the sternomastoid is totally paralyzed, freedom of movement of the head and neck is impaired, but it is not abolished, even when both muscles are entirely put out of service, the erect position of the head is not seriously interfered with. With the rare exception of penetrating wounds at the base of the skull, extracranial lesions of the spinal accessory are always confined to the external branch, and are nearly always traumatic. Neuritis of this nerve is rare.

Paralysis of the trapezius is indicated by great disability in raising the shoulder and in adducting the shoulder-blade. The arm cannot be elevated much above an angle of ninety degrees, the sufferer is practically deprived of the use of his arm for all heavy work. Complete trapezius paralysis is a serious calamity to any one, but especially to a laboring man. Forming, as it does, the most important support of the shoulder, the loss of the trapezius practically does away with the power of lifting weights which are at all heavy. The deltoid, in losing its support, loses much of its usefulness, and lifting must be done by the flexion of the forearm and by a bending of the whole body.

The assumption that occasionally there is a variation from the customary route by which the motor impulses pass from the spinal cord to the trapezius receives some support from the fact that the trapezius is not, in its anatomic relations, a fixed muscle. In man it may be congenitally absent in whole or in part, in the lower apes it is supplemented by another similar muscle called

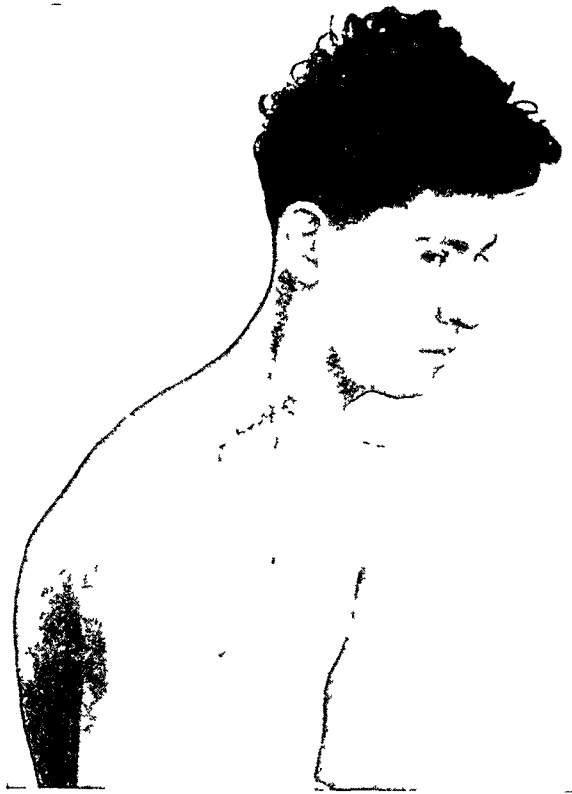


FIG 7 —Oblique view of post-operative trapezius paralysis, showing forward droop of shoulders and of head. Note relative prominence of bones of shoulder girdle. Fresh scars due to reoperations for diseased nodes.

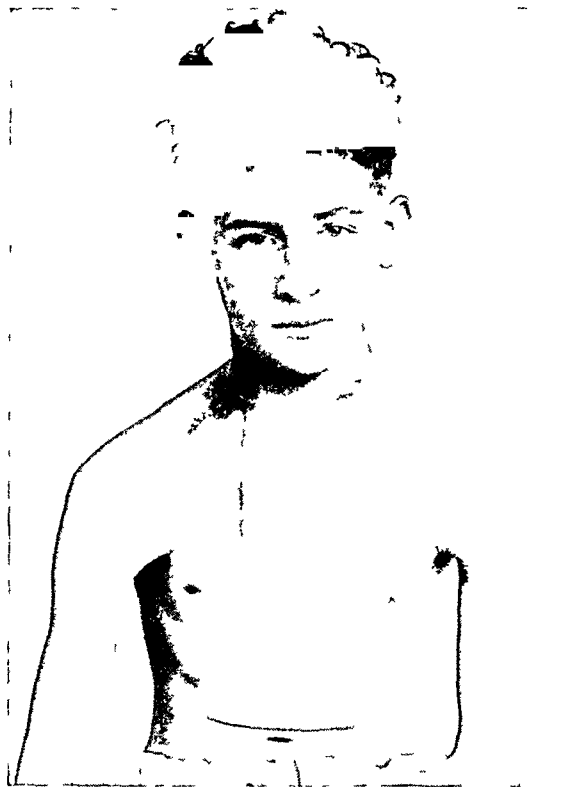


FIG 8 —Anterior view of post-operative trapezius paralysis. Note depth of supraclavicular fossæ, simulating the depression produced by apical tuberculosis.



## PARALYSIS OF BOTH TRAPEZII MUSCLES

the spinocervicalis Bailey takes this variation in the case of the trapezius to be as follows (Fig 9)

The spinal centre situated between the first and fifth cervical segments of the cord is fixed and constant. As a general rule, the cells of this centre send their axons to the trapezius through both the spinal accessory and the cervical nerves. But sometimes there is a variation from this arrangement in that all the axons pass to the muscle in the spinal accessory, leaving the cervical nerves without function, as far as the trapezius is concerned. Under these circumstances, the motor impulses reach the trapezius exclusively through the spinal accessory, and section of it consequently means total palsy.

What can be done for operative paralysis of the spinal accessory nerve?

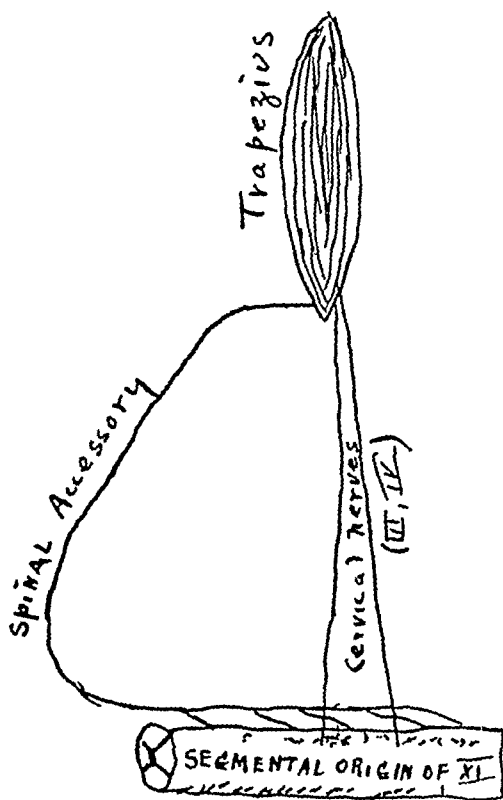


FIG 9—Scheme showing kindred segmental origin from cord of nerves supplying trapezius. The suprascapular nerve arises chiefly from the fifth cervical segment.

We have seen that, according to Mathews, the spinal accessory nerve can be accidentally divided and the injury not followed by shoulder drop. At times the nerve is intentionally severed at operation for the purpose of thorough extirpation of diseased lymph-nodes, here immediate suture of the severed ends is, of course, indicated. In Bailey's second case neurorrhaphy was performed about six weeks after the original operation. The cut ends of the nerve were found to be considerably separated—an inch or more. Within a few weeks from the suturing, the electric reaction improved.

What is to be the treatment when the trapezius branch of the spinal accessory nerve has been extensively resected, and the distal portion of the nerve, beneath the trapezius, can alone be found? The gap is too great for tubulization to be practicable, and nerve transplantation would be of doubtful



utility For such a case the author suggests the following nerve-anastomosis operation He would have attempted it in the present case, but for the presence of pus in the operative field

The suprascapular nerve, which supplies the supra- and infraspinatus muscles, is in close relationship with the trapezius branch of the spinal accessory nerve as it enters the trapezius muscle The suprascapular nerve is derived from the fifth and sixth cervical segments, the spinal portion of the spinal accessory is derived in part from the fifth cervical segment It is proposed, then, to isolate the trapezius branch of the spinal accessory and the suprascapular nerve, to split the suprascapular nerve, and to anastomose the proximal stump of the split portion of the suprascapular nerve to the distal trapezius stump of the spinal accessory This proposed nerve-anas-

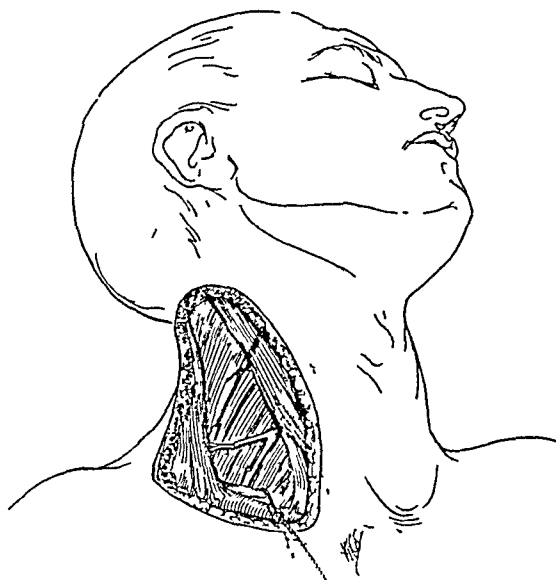


FIG 10.—Sketch showing author's proposed nerve anastomosis operation when there is a wide gap between ends of resected spinal accessory nerve The suprascapular nerve is seen split above the retracted omohyoid muscle and the split end has been anastomosed to the distal end of the spinal accessory close to the border of the trapezius The missing portion of the spinal accessory nerve is indicated by shading The proximal portion of the latter appears from beneath the sternomastoid

tomosis is at least as rational as the anastomosis of the spinal accessory with the facial nerve, and probably more rational, because of the close segmental relationship of the suprascapular and spinal accessory nerves

DR NATHANIEL GINSBURG said that it is not unusual to find in the dissecting room that the spinal accessory nerve occasionally breaks up into a plexus in the substance of the sternomastoid muscle, and fails to reform into the nerve trunk which generally leaves the upper posterior border of this muscle to pass to the trapezius muscle, and with the third and fourth cervical branches to form the subtrapezius plexus It does not follow that division of the spinal accessory nerve will always be succeeded by shoulder drop, with anterior rotation, because the cervical nerves may suffice to innervate the muscle

In the patient presented, it is apparent that bilateral division of the nerve

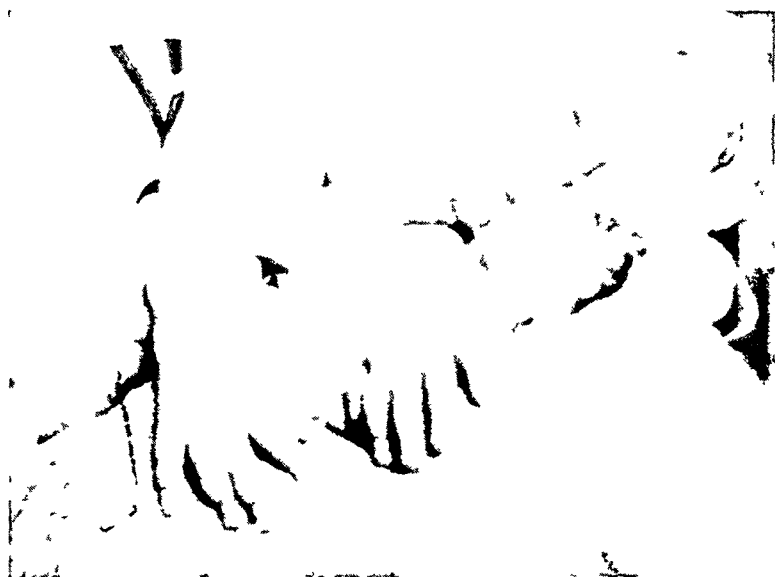


FIG 11



FIG 12



## MULTIPLE ENCHONDROMATA OF HAND

supply of both trapeziu muscles has taken place, and that the injury is not confined to the spinal accessory nerves alone. It is not unlikely that the nerve supply of the rhomboideus major and minor has likewise been cut, since there is evidence of relaxation of these muscles. The introduction of a firm interscapular ligament of fascia lata would perhaps be of assistance in this case in bringing and maintaining the normal position of the scapulæ.

## MULTIPLE ENCHONDROMATA OF HAND

DR A. BRUCE GILL presented a male child of two and a half years, whose X-ray photographs (Figs 11 and 12) showed multiple enchondromata of the right hand only. Four metacarpals and nine phalanges are involved. X-ray plates of the other bones of the body show no evidence of enchondromata.

The child is healthy and well developed. He has never been ill with the exception of a furunculosis about a year ago. His parents are healthy and there is no family history of enchondromata, or hereditary deforming chondrodysplasia, as Ehrenfried terms it, for a period of at least three generations.

The child's parents first observed three or four months ago that his right hand seemed fatter, as they thought it, than it had been before. He has never complained of any pain or any discomfort in the hand, and he uses it for all ordinary purposes. Examination showed demonstrable enlargement of several of the phalanges and the metacarpals.

The subject of multiple enchondromata, or hereditary deforming chondrodysplasia, together with its literature, has been presented well in recent years by Boggs in the Transactions of the Association of American Physicians, Philadelphia, 1913, by Ehrenfried, Jour. A. M. A., May 15, 1915, by Ashurst, ANNALS OF SURGERY, 1916, vol. 61, p. 167, by such others as Oberndorf, Clark and Atwood, Fragenheim, Schmidt, Lubarsch, Carman and Fisher, and others referred to in the above papers.

Various theories as to its etiology have been advanced, and many diseases such as syphilis, tuberculosis, and other infections, rhachitis, thyroid deficiency, trophic changes in the central nervous system have been suggested as causes. But the best opinion appears to be that it is a congenital condition due to abnormal *anlage* in the intermediary cartilage of the bones involved, and that frequently heredity plays a part. Certain cases said by Boggs to have been reported in the new-born, and the case here presented in a child two and a half years of age strongly indicate that the condition is truly a congenital one. The hereditary influence cannot always be traced, nor is the underlying cause of the congenital abnormality apparent.

## CORRESPONDENCE

### TRAUMATIC ANEURISM OF THE TEMPORAL ARTERY

TO THE EDITOR OF THE ANNALS OF SURGERY

DEAR SIR

IN the ANNALS OF SURGERY for March, 1917, Dr J Shelton Horsley, in recording seven cases of traumatic aneurism of the temporal artery, states that, in the literature of the last twenty years, these are the only cases which can be found, the condition being apparently of some rarity. I therefore venture to append an epitome of a case recorded by myself in the *St Bartholomew's Hospital Journal* of September, 1916. This case resembles, in many respects, that described by E Holzwarth.

*Aneurism of right superficial temporal artery.* The patient was a young soldier. Four months previously a bullet entered the skin over the base of the right mastoid process, passed through the ear and emerged on the face, one inch in front of the external meatus.

*Present Condition.*—The right superficial temporal artery is dilated for two inches to a diameter of a quarter of an inch, being three times as large as its fellow. The dilatation commences at the upper border of the zygoma and extends upward. There is no paralysis of the upper branches of the facial nerve. Since the injury the hearing power of the right ear has greatly diminished, a watch being heard only at half an inch from the ear.

The symptoms produced are slight. The patient complains of vague pains in many areas of the scalp, and is conscious of the pulsation whenever he takes active exercise.

If severe symptoms develop, or if the aneurism increases, it is proposed to excise the dilated portion of the artery.

C HAMILTON WHITEFORD, M R C S

31st July, 1917

5, Sussex Terrace, Plymouth, England

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# ANNALS *of* SURGERY

VOL LXVI

DECEMBER, 1917

No. 6

## STUDIES IN BONE REGENERATION

AN EXPERIMENTAL STUDY OF BONE TRANSPLANTATION BY MEANS OF A VITAL STAIN

BY BARNEY BROOKS, M D

OF ST LOUIS, MO

(From the Department of Surgery, Washington University Medical School)

SINCE the times Ollier and Barth recorded their divergent views on the fate of free bone transplants, numerous investigators have contributed their observations and beliefs as regards this problem, and there has not yet been an agreement on some of the most important questions

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erties Baschirzew and Petrow believe that the periosteum is of value in the clinical use of bone grafts, not for the reason of its having osteogenetic properties, but because it aids in directing and protecting new bone growth McWilliams believes that the periosteum is important in the clinical use of the bone graft for the reason that it serves to obtain nutrition for the transplant Lobenhoffer found that, following the transplantation of bone with periosteum, the cortical bone degenerated and was absorbed and that the periosteum remained viable and produced new bone Murphy, and Brown and Brown believed that the most vital factor in determining the viability and growth of a bone transplant was that the transplant should be placed in contact with living osteogenetic bone McWilliams found that bone transplants remained viable and regenerated bone when the transplant was entirely separated from bone tissue

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MacEwen believed that bone regenerated only from the cortical bone cells, and that the periosteum had no osteogenetic function and acted as limiting membrane for bone formation Axhausen expressed the view that bone regenerated from periosteum and endosteum and to some extent from the cortical bone cells, but he emphasized that in the free bone transplant the greater part of the cortical bone degenerated and was absorbed, owing to the fact that it was mechanically impossible for it to obtain adequate nourishment Nakhara and Dilger, Jako<sup>1</sup>, Trinci, Pochhammer, Schepelmann, Mayer and Wehner found that free transplants of periosteum regenerated bone in a certain proportion of instances Carrel has cultivated periosteum in the thermostat and subsequently transplanted the growing cells and found bone formation Graves, Gaille and Robertson, Brown and Brown, Albee, and others have found that free transplants of periosteum do not form bone, and they state that periosteum has no osteogenetic properties Baschirzew and Petrow believe that the periosteum is of value in the clinical use of bone grafts, not for the reason of its having osteogenetic properties, but because it aids in directing and protecting new bone growth McWilliams believes that the periosteum is important in the clinical use of the bone graft for the reason that it serves to obtain nutrition for the transplant Lobenhoffer found that, following the transplantation of bone with periosteum, the cortical bone degenerated and was absorbed and that the periosteum remained viable and produced new bone Murphy, and Brown and Brown believed that the most vital factor in determining the viability and growth of a bone transplant was that the transplant should be placed in contact with living osteogenetic bone McWilliams found that bone transplants remained viable and regenerated bone when the transplant was entirely separated from bone tissue



Haas states that regeneration of new bone was never found excepting where periosteum was present. Bier and Haas emphasize the stimulative effect of the presence of blood clot in new bone production. Phemister found that new bone was regenerated from the periosteum and endosteum and to a small extent from the cortical bone cells. He believed the transplanted bone was slowly replaced by the new-formed bone. He emphasized the importance of "functional demand" as a factor in determining the survival and growth of a bone graft.

In a previous publication it was pointed out that sodium alizarine sulpho-nate had specific vital staining properties for bone tissue. When this dye is given to animals by mouth or subcutaneously it stains only the newly formed bone. This method gives the observer a means of easily determining in gross the amount and site of all new bone formed.

This experimental study of bone regeneration from bone transplants is based on the use of sodium alizarine sulpho-nate as a vital stain for new bone. The experimental method was the same in all experiments. Dogs were used as the experimental animals. The operations were all done under complete ether anæsthesia. The aseptic precautions were such that infection of the operation wounds did not occur in any instance. A defect in the shaft of the ulna was produced by the excision of 20-40 mm of the bone with its periosteum. In the earlier experiments, *e g*, No 33, the periosteum was not completely removed along the attachment of the interosseous membrane, between the ulna and the radius, and regeneration of bone was found to take place along the course of the remaining periosteum. Later it was found that the periosteum could be removed entirely if the interosseous membrane was divided before any attempt was made to remove the bone. Numerous experiments have convinced us that the shaft of the ulna in the dog will not regenerate if the periosteum is completely removed along with 4 cm of the shaft.

The bone transplant or implant was placed in the defect of the ulna. In most experiments the bone transplant or implant was fixed in the medullary canals of the fragments of the resected bone. Living bone transplants were always obtained from the femur. The grafts were cut with a motor saw. Abundant irrigation with salt solution was always used to prevent the saw from becoming hot. In experiments in which the periosteum and endosteum were transplanted with the graft, great care was taken that the periosteum was not detached from the transplant. In those experiments in which the periosteum and endosteum were removed from the transplant they were completely removed along with adjacent layers of cortical bone. The sterile dry bone implants were obtained from old laboratory specimens of bones of dogs which had been sacrificed in other experimental work. The specimens were old formalin preserved specimens which had been dry for several weeks. Silk was used in all experiments as suture and ligature material. The operative wounds were closed with the Halsted epithelial stitch. A plaster-of-Paris dressing was applied to the foreleg of all

## STUDIES IN BONE REGENERATION

dogs operated upon This dressing was left for variable lengths of time In all experiments the animals used the operated legs without apparent discomfort All animals were given subcutaneous or intraperitoneal injections of sodium alizarine sulphonate In most of the experiments an injection of 3 c.c. of a saturated solution of the dye diluted with sterile water was given intraperitoneally once each week

The following series of experiments were carried out

I Autogenous transplantation of living bone with periosteum and endosteum Six (6) experiments

II Autogenous transplantation of living bone without periosteum and endosteum Four (4) experiments

III Implantation of dried sterile bone Four (4) experiments

### I EXPERIMENTS WITH AUTOTRANSPLANTS OF LIVING BONE WITH PERIOSTEUM AND ENDOSTEUM

*Experiment No. 26*—Young dog November 20, 1916 Autotransplantation of living bone with periosteum and endosteum Seven days

Ether anaesthesia Incision in right thigh Femur exposed With a motor saw a bone graft 25 mm long and 2 mm broad was cut from full thickness of the cortex of the femur Periosteum and endosteum on graft intact Wound in thigh closed

Incision in left foreleg 25 mm of ulna removed with periosteum Bone graft from femur placed in defect Wound closed

Two cubic centimetres of a saturated aqueous solution of sodium alizarine sulphonate were given daily subcutaneously

November 27, 1916, seven days, wounds healed *per primam* Animal sacrificed Right femur and bones of the left foreleg placed in formalin

*Macroscopic Examination*—There was very slight pink color under the periosteum of all bones There were distinct red zones at the epiphyseal lines The new bone which was forming about the area of excision of the shaft in the femur was stained The ends of the stumps of the resected ulna were colored The graft was in good position in the defect The proximal end of the graft was in contact with the medulla of the proximal stump The distal end of the graft lay in contact with the periosteum of the distal stump There was no evidence of new-formed bone along the graft The specimen was decalcified and microscopical section prepared of the stumps of the ulna and entire length of the graft

*Microscopical Examination*—There was a marked proliferation of cells from the endosteum and periosteum of the stump of the resected bone Trabeculae of new bone were being formed The graft was surrounded by granulation tissue The lacunae in the bone graft were for the most part entirely empty There were small areas scattered throughout the entire length of the graft in which the lacunae contained cells with normal staining properties The periosteum and endosteum of the graft for the most part could not be distinguished There were, however, small areas in which the periosteum and endosteum had remained viable and in which there was definite proliferation of cells of the osteoblast type

*Experiment No. 27*—Adult dog November 21, 1916 Autotransplantation of living bone with periosteum and endosteum, fourteen days

Ether anaesthesia Incision in right thigh Femur exposed Bone graft 3

cm long and 2 mm thick cut from full thickness of cortex of shaft of femur Periosteum and endosteum on graft intact Wound in thigh closed

Incision in right foreleg 3 cm of shaft of ulna with periosteum removed Bone graft from femur placed in defect Ends of graft in contact with stumps of resected ulna Wound closed

The animal was given on alternate days a subcutaneous injection of 2 c c of a saturated aqueous solution of sodium alizarine sulphate

December 5, 1916, fourteen days Animal developed several abscesses in back at sites of subcutaneous injections of the vital stain Sacrificed All bones showed a very faint pink color The femur from which the graft was cut showed the defect filled with callus in which there were areas of ossification There was also subperiosteal new bone formation about the site of removal of the graft All new formed bone was stained red

The ulna which was resected showed a very striking picture The bone transplant was in perfect position between the stumps of the resected bone The transplant was not colored Along the periosteal and endosteal sides of the transplant there were numerous small red dots With a hand lens these small red areas were clearly small islands of new bone formation (Fig 1, Plate I) There was also new bone formation at the ends of the stumps of the resected ulna The distribution of the small islands of growing bone along the entire length of the transplant showed clearly that the bone was growing from the graft Moreover, the new bone formation was only from the periosteal and endosteal sides of the transplant Microscopic sections were prepared of the entire length of the transplant and stumps of the resected ulna

*Microscopical Examination*—Sections showed that the lacunæ of the greater portion of the transplanted bone were empty, and these portions of the transplant were obviously not viable In other areas the lacunæ contained nuclei with normal staining properties There was no evidence of any particular portion of the transplant remaining viable, but the areas with the lacunæ containing nuclei which stained normally were irregularly distributed throughout the entire graft Some small spicules of cancellous bone were as obviously completely nonviable as areas in the depths of the dense cortex There was no evidence of proliferation of any of the cells of the lacunæ Whether these nuclei with the normal staining properties were bone cells which had remained viable, or whether they were cells which had wandered into the lacunæ from the surrounding tissues could not be determined This question will be discussed later

Along the periosteal and endosteal surfaces of the transplant there were areas in which the periosteum and endosteum had remained viable There was proliferation of cells in these areas with the beginning formation of bone trabeculæ In other areas there was no evidence of viable periosteum or endosteum There was no evidence of bone production at any site in which there was not evidence of viable periosteum or endosteum

There was also growth of new bone from the periosteum and endosteum of the ends of the stumps of the resected ulna The areas of beginning new bone formation along the graft were certainly independent of the growth of new bone from the stumps of the resected ulna

*Experiment No 35*—Young dog December 9, 1916 Autotransplantation of living bone with periosteum and endosteum, twenty-seven days

Ether anæsthesia Incision right thigh Bone graft 35 mm by 2 mm cut from full thickness of cortex of femur Periosteum and endosteum intact Wound closed Incision in right foreleg 30 mm of the shaft of the ulna with periosteum resected Bone graft placed in defect with ends of graft in medullary cavities of the stumps of the resected bone Wound closed Plaster dressing on foreleg

# PLATE I



FIG 1—Experiment No 27 Autotransplantation of living bone with periosteum and endosteum. The transplant is unstained. There is regeneration of bone on the periosteal and endosteal sides of the transplant. The amount of new bone formed is slightly exaggerated in the illustration.

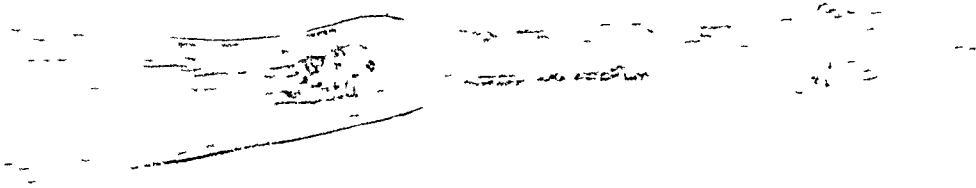


FIG 2—Experiment No 35 Autotransplantation of living bone with periosteum and endosteum. Twenty-seven days. The transplant is united to the stumps of the resected bone by callus. There is new bone formation along the entire transplant.

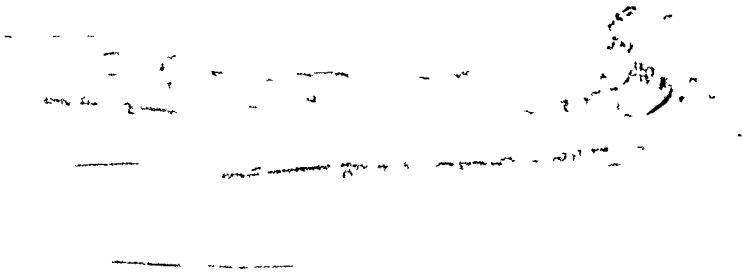


FIG 3—Experiment No 28 Autotransplantation of living bone with periosteum and endosteum. Fifty-six days. Showing regeneration of bone along entire length of the transplant. The transplanted bone shows evidence of absorption.

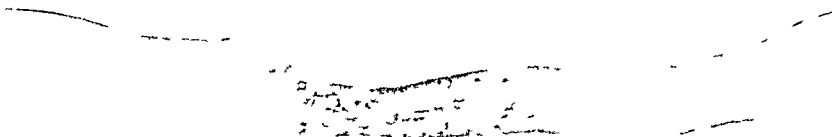


FIG 4—Experiment No 45 Autotransplantation of living bone with periosteum and endosteum. One hundred and five days. Showing complete regeneration of resected bone.



## STUDIES IN BONE REGENERATION

The animal was given 2 c c of a saturated aqueous solution of sodium alizarine sulphonate subcutaneously for one week, and thereafter 3 c c of the saturated aqueous solution of the dye once a week intraperitoneally

January 5, 1917, twenty-seven days Operative wounds healed *per primam* Animal sacrificed There was a thin layer of pale rose-pink bone under the periosteum of all bones There was staining of the bone on the diaphyseal side of the epiphyseal lines The ends of the stumps of the resected ulna were red The bone transplant was in perfect position Each end of the transplant was joined to the stump of the resected bone by a callus The graft was surrounded by a mass of tough fibrous tissue to which it was firmly attached There was new bone formation along the entire length of the graft The new formed bone was for the most part along the sides of the graft which were covered by periosteum and endosteum There was, however, some new bone formation on all sides of the graft (Fig 2, Plate I) Microscopic sections of the entire length of the graft and the stump of the resected ulna were prepared

*Microscopical Examination*—The sections were cut in a plane parallel to the length of the graft and perpendicular to the periosteal and endosteal surfaces of the transplant In some parts of the transplant the lacunæ were completely empty and the bone was obviously nonviable In other parts the lacunæ contained nuclei which had normal staining properties Throughout the entire graft there was evident absorption of the bone by giant cells and granulation tissue (Fig 15, Plate IV) On the periosteal surface of the transplant there was marked new bone formation (Fig 13, Plate IV) In like manner there was formation of new bone trabeculæ on the endosteal surface of the transplant (Fig 14, Plate IV) The transplant was united to the ends of the stumps of the resected bone by a mass of fibrous tissue There was no evidence of continuity between the new bone produced about the transplant and that produced from the stumps of the resected ulna

*Experiment No 28*—Adult dog January 4, 1917 Autotransplantation of living bone with periosteum and endosteum, fifty-six days

Incision left thigh Bone graft 60 mm by 2 mm cut with motor saw from full thickness of cortex of femur Periosteum and endosteum on graft intact Bone graft from femur placed in defect Ends of transplants fixed in medullary cavities of stumps of resected bone Wound closed

Incision in right foreleg 40 mm of shaft of ulna with periosteum removed No transplant used in defect Wound closed Plaster dressings on forelegs

The animal was given 3 c c of a saturated aqueous solution of sodium alizarine sulphonate intraperitoneally once a week The operative wounds healed *per primam* The plaster dressings were removed at the end of six weeks

March 1, 1917, fifty-six days Animal sacrificed The bones other than those operated upon were unstained The epiphyseal cartilages had disappeared, but the lines of junctions between epiphyses and diaphyses could be indistinctly seen The portion of the shaft of the right ulna which was excised had not regenerated The bone transplant in the left ulna was in perfect position There was growth of new bone at the ends of the stumps of the resected bone There was also some subperiosteal new bone formation along the shaft of the radius in the region of the defect in the ulna The transplant was united to each stump by callus, which was similar to the callus formed after a fracture There was new bone formation along the entire length of the transplant The bone graft had lost its original outlines In some areas it was obviously being absorbed The amount of new bone formed was least in the middle of the transplant and most at the ends (Fig 3, Plate I) The specimen was decalcified and microscopic sections made

*Microscopical Examination*—Longitudinal sections of the entire length of the

graft and the stumps of the resected ulna were examined. The original outlines of the transplant were fairly well defined. The transplant was obviously in the process of being absorbed. It was surrounded for its entire length by an envelope of new formed bone. The transplant and envelope of new bone were arranged similarly to a sequestrum and involucrum. In some areas of the remaining part of the transplant the lacunæ were empty. In other areas the lacunæ contained nuclei which had normal staining properties. All the spaces in the transplant were permeated by blood-vessels and connective tissue. Each end of the transplant was united to a stump of the resected ulna by fibrocartilaginous tissue.

*Experiment No 45*—Adult dog. January 11, 1917. Autotransplantation of living bone with periosteum and endosteum, one hundred and five days.

Incision in left thigh. Bone graft 40 mm by 2 mm cut with motor saw from full thickness of cortex of femur. Periosteum and endosteum intact. Wound closed. Incision in right foreleg. 30 mm of shaft of ulna with periosteum resected. Bone graft transplanted into defect. Transplant fixed firmly in medullary cavities of fragments of resected bone. Wound closed. Plaster dressing.

The wounds healed *per primam*. The plaster-of-Paris dressing was removed at the end of ten weeks. The animal was given, once a week, an intraperitoneal injection of 3 c.c. of a saturated solution of sodium alizarine sulphonate.

April 24, 1917, 105 days. Animal sacrificed. All bones were a pale rose-pink color. The epiphyseal cartilage in the distal end of the ulna had almost completely disappeared. The bones indicated a young adult dog. The defect in the ulna was completely repaired by well-stained bone. There was complete regeneration of a functioning shaft (Fig 4, Plate I). The bone was sectioned longitudinally through the grafted area. The junction of the distal fragment and the graft could only be distinguished by the differences in diameter. A medullary cavity was forming in the grafted area. The junction of regenerated area and the proximal fragment was very distinct. Within the deeply stained bone at this point there was a small area of unstained bone which probably represented the only remaining part of the original transplant. This unstained bone was clearly being absorbed in the process of the formation of a medullary cavity in the grafted area (Fig 5, Plate II).

*Microscopical Examination*—Longitudinal sections of the entire transplanted area were examined. There was complete regeneration of the entire defect. The point of union of the graft and the distal stump of the ulna could not be distinguished. The union of the graft and the proximal stump of the ulna was clearly marked by a thin disk of cartilage. No evidence of any remaining part of the original transplant could be found. Characteristic bone marrow was present throughout most of the length of the grafted area.

*Experiment No 38*—Old dog. December 14, 1916. Autotransplantation of living bone with periosteum and endosteum, fifty-five days.

Incision right foreleg. 30 mm of shaft of ulna with periosteum resected. Wound closed.

January 4, 1917. Operative wound healed *per primam*. No evidence of regeneration of resected bone. Incision in left thigh. Bone graft 35 mm by 2 mm cut with motor saw from full thickness of cortex of femur. Periosteum and endosteum intact. Incision in right foreleg. Bone graft placed in defect in right ulna. Wound closed. Plaster dressing on foreleg.

The animal was given once a week 3 c.c. of a saturated aqueous solution of sodium alizarine sulphonate intraperitoneally. The wounds healed *per primam*.

February 27, 1917, fifty-five days. Animal sacrificed. All bones except those operated on showed very little or no staining. The defect in the femur was filled with new bone stained red. There was no subperiosteal new bone forma-

## PIATE II

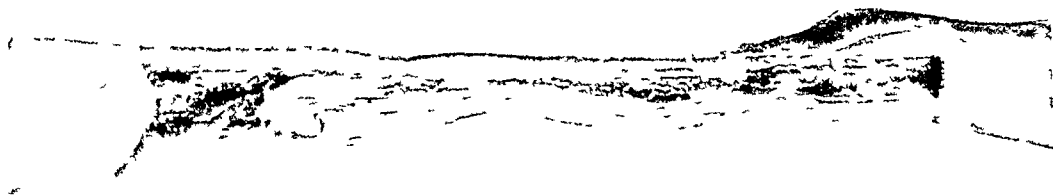


FIG 5—Experiment No 45 Autotransplantation of living bone with periosteum and endosteum One hundred and five days Cross-section of the regenerated area shown in Fig 4, Plate I Showing the development of a medullary cavity in the transplanted area

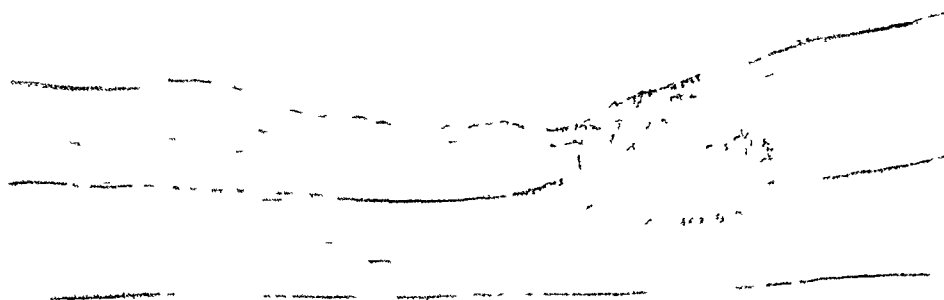


FIG 6—Experiment No 38 Autotransplantation of living bone with periosteum and endosteum Fifty-five days Showing the failure of the transplant to regenerate the bone defect Note the relatively small amount of bone regeneration from the stumps of the resected bone, and complete absence of general staining of bones

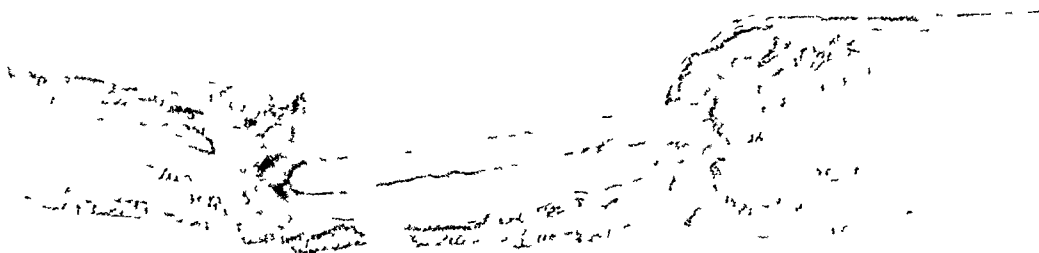


FIG 7—Experiment No 33 Autotransplantation of living bone without periosteum or endosteum Fourteen days Showing that there is no regeneration of bone from the transplant Note the bridge of bone which has regenerated from the periosteum which was not completely removed at operation

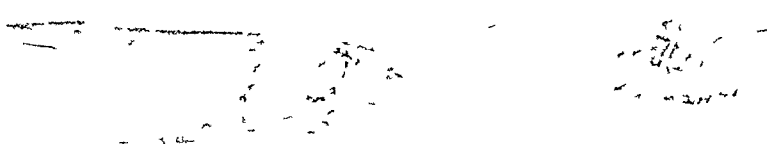


FIG 8—Experiment No 42 Autotransplantation of living bone without periosteum or endosteum Twenty-six days Showing that there is no regeneration of bone from the transplant





tion about the site of the excision of the graft in the femur. The bone graft in the foreleg was in excellent position. There was no new bone formation from the distal stump of the resected ulna. The end of the proximal fragment was united to the shaft of the radius by a callus. In this callus there was new bone formation. The distal end of the bone transplant had been completely absorbed. There was at the proximal end of the transplant a very small amount of new bone formation. The transplant as a whole was being absorbed, and there was no evidence that the defect in the ulna would have been repaired (Fig 6, Plate II). The specimen was decalcified and microscopic sections prepared.

*Microscopical Examination*—Section of the entire length of the graft and the ends of the stumps of the resected ulna were examined. The distal third of the transplant was entirely absorbed and replaced by fibrous tissue. In this fibrous tissue there was no evidence of bone or bone-producing tissue. The proximal two-thirds of the transplant was clearly in the process of being absorbed. The lacunæ of some parts of the graft contained nuclei with normal staining properties. In other areas the lacunæ were empty. Blood-vessels and connective tissue permeated spaces in the transplant. Near the proximal end of the transplant there was a small island of new bone formation which seemed to be derived from the transplant, but may have been derived from the stump of the resected bone. Microscopical examination confirmed the observations of the gross examination.

Experiments Nos 26, 27, 28, 35, and 45 illustrate a series of stages of the regeneration of a defect in the shaft of a bone following the transplantation into this defect of a living bone graft with periosteum and endosteum. By means of the vital stain it was possible to determine the exact site of origin of the bone regeneration and to trace the process through successive stages to a complete restoration of the original bone shaft. Also the method of study by means of the vital stain was supplemented in each experiment by microscopical examination of the transplant.

In Experiment No 26, in which the animal was sacrificed seven days after the bone transplantation, there was no regeneration of bone from the transplant. Microscopical examination, however, showed that portions of the periosteum and endosteum of the transplant had remained viable and that there was a proliferation of bone-producing cells from the viable areas. In Experiment No 27, in which the examination was made fourteen days after the bone transplantation, there was regeneration of new bone along the periosteal and endosteal sides of the transplant, and the distribution of the bone regeneration equally along the entire length of the transplant without any evidence of a continuity of the new bone formed along the graft with that produced from the stumps of the resected bone was conclusive proof that the bone regeneration was from the transplant and not from the stumps of the resected bones along the course of the transplant. In Experiment No 27, in which the specimen was examined twenty-seven days after the transplantation, there was a larger amount of new bone formed from the graft. The transplant was united to the ends of the stump of the resected bone by callus. The bone matrix of the transplant was in part clearly nonviable, and in other parts showed the microscopic picture of living bone. The bone matrix was in some areas clearly in the process of being absorbed. In Experiment No 28, in which the

animal lived fifty-six days after operation, the regeneration of new bone and the absorption of the bone matrix of the transplant had progressed still further. Finally in Experiment No 45, which was of 105 days' duration, the defect in the shaft had completely regenerated. The identity of the transplant had completely disappeared. A normal marrow cavity had developed in the regenerated area.

In Experiment No 38, in which the method used was the same, and in which the postoperative course of the animal differed in no way from the other experiments in this group, there was a complete failure of the transplant to show evidence of regeneration of bone. It is significant that there was very little new bone formation at the site of the removal of the graft from the femur and from the stumps of the resected ulna. This failure of the transplant to generate new bone was due to the limited osteogenetic properties of the bone from which it was removed. The fact that the animal was an old dog explains the low osteogenetic properties of the bones.

## II EXPERIMENTS WITH TRANSPLANTS OF LIVING BONE WITHOUT PERIOSTEUM OR ENDOSTEUM

*Experiment No 33*—Young dog December 4, 1916 Autotransplantation of bone without periosteum and endosteum, fourteen days

Incision in left thigh Bone graft 50 mm by 1 mm cut from full thickness of cortex of femur Periosteum and endosteum removed from graft Wound closed Incision in left foreleg Forty mm of shaft of ulna resected with periosteum Bone graft from femur from which the periosteum and endosteum was removed was transplanted into the defect The transplant was fixed in the medullary canals of the stumps of the resected bone Plaster dressing

The animal was given 2 cc of a saturated aqueous solution of sodium alizarine sulphate subcutaneously on alternate days The wounds healed *per primam*

December 18, 1916, fourteen days Animal dead Cause of death was intestinal intussusception The epiphyseal cartilages were all present There was staining of all of the bones on the diaphyseal sides of the epiphyseal cartilages The shafts of the bones other than those operated on were unstained There was an unusually large amount of new bone formation about the site of the excision of the graft in the femur This new bone was stained a bright-red color The bone graft in the resected ulna was in good position There was marked new bone formation at the ends of the stumps of the resected ulna The transplant showed no color It appeared completely necrotic It was not attached to the surrounding tissues Between the transplant and the radius there was a bridge of new-formed bone which connected the two fragments of the resected ulna This was clearly a regeneration from a strip of periosteum which was left along the interosseous membrane when the portion of the shaft was resected (Fig 7, Plate II) The regeneration was entirely independent of the bone transplant Microscopic sections of the transplant and the surrounding tissue were prepared

*Microscopical Examination*—Sections of the transplant showed the lacunæ empty and the entire transplant was obviously nonviable There was no evidence of regeneration of bone at any point in or about the graft The small stained spots seen in the surrounding connective tissue proved to be calcification of degenerated muscle fibres

## STUDIES IN BONE REGENERATION

*Experiment No 39*—Adult dog January 6, 1917 Autotransplantation of bone without periosteum or endosteum, twenty-one days

Incision in right thigh Bone graft 40 mm long and 1 mm wide cut from full thickness of cortex of the shaft of femur with motor saw Wound closed  
Incision in right foreleg Thirty mm of shaft of ulna removed with periosteum The periosteum and endosteum were completely removed from the graft cut from the femur The transplant was placed in the defect in the ulna The ends of the graft were fixed in the medullary cavities of the stumps of the ulna Wound closed Plaster dressing

The wounds healed *per primam* The animal was given on the seventh and fourteenth days an intraperitoneal injection of 3 c c of a saturated aqueous solution of alizarine sulphonate

January 27, 1917, twenty-one days Animal died Cause of death was intestinal intussusception There was very slight general staining of the bones The distal epiphyseal cartilage of the ulna had disappeared The distal epiphyseal cartilage of the femur was present There was quite a large amount of well-stained new bone formed about the site of the excision of the graft from the femur The bone transplant was in good position There was new bone formation from the stumps of the resected ulna No evidence of any growth of bone from the transplant The transplant was in part adherent to the surrounding tissue Microscopical sections of the transplant were prepared

*Microscopical Examination*—Sections of the entire length of the graft and the stumps of the resected ulna were examined In portions of the transplant the lacunæ contained no nuclei and the bone matrix was obviously nonviable In other areas the lacunæ contained nuclei with normal staining properties In many of the Haversian canals there were blood-vessels containing red blood cells In the areas of the graft in which there were blood properties the microscopical picture was that of viable bone There were many areas in which the transplant was obviously being absorbed by giant cells and granulation tissue There was no evidence of bone regeneration at any point in or about the transplant There was marked regeneration of bone from the periosteum and endosteum of the stumps of the resected ulna

*Experiment No 42*—Young dog January 10, 1917 Autotransplantation of bone without periosteum and endosteum, twenty-six days

Incision in right thigh Bone graft 45 mm long and 2 mm wide cut from the full thickness of cortex of shaft of femur Wound closed Incision in right foreleg 40 mm of shaft of ulna with periosteum removed Periosteum and endosteum completely removed from bone graft from femur Transplant placed in defect of ulna

The wounds healed *per primam* The animal was given, once a week, an intraperitoneal injection of 3 c c of a saturated aqueous solution of sodium alizarine sulphonate

February 5, 1917, twenty-six days Animal died No general staining of bones Epiphyseal cartilages were all present There was new bone formation from the stumps of resected bone Subperiosteal new bone formation was present on shaft of radius in region of resection of ulna, and on the femur in the region of the excision of the transplant The transplant was in excellent position Both ends of the transplant were fixed in the medullary canals of the stumps of the resected ulna There was no regeneration of bone from the transplant (Fig 8, Plate II)

*Experiment No 46*—Adult dog January 13, 1917 Autotransplantation of bone without periosteum or endosteum, seventy-eight days

Incision in right thigh Bone graft 40 mm long and 1 mm wide was cut from the full thickness of the cortex of the shaft of the femur Wound closed

Incision in right foreleg Thirty mm of the shaft of the ulna was removed with the periosteum The periosteum and endosteum with the adjacent layers of bone were scraped away from the graft from the femur The transplant was placed in the defect in the resected ulna The transplant was firmly fixed in the medullary cavities of the stumps of the resected bone Wound closed Plaster dressing

The wounds healed *per primam* The plaster dressing was removed after three weeks The animal was given, once a week, an intraperitoneal injection of 3 c c of a saturated aqueous solution of sodium alizarine sulphonate

April 2, 1917, seventy-eight days The animal died of general peritonitis following the last injection of the dye There was slight staining of all bones The epiphyseal cartilages were absent, but the junctions of the epiphyses and diaphyses were all distinct There was a large amount of well-stained new bone about area of excision of graft in femur The bone transplant was in excellent position There was a large amount of new bone formed at the end of the proximal fragment of the resected ulna This new bone had grown alongside of transplant for a distance of 1 cm (Fig 9, Plate III) There was very little new bone formation from the stump of the distal fragment The transplant was being absorbed The distal two-thirds was irregular and smaller than original transplant The transplant was adherent to the surrounding tissue At the junction of the middle and distal thirds of the transplant there was a small island of new bone, which was not continuous with the new bone formed along the proximal third of the transplant Microscopical sections of the entire length of the transplant and the stump of the resected ulna were prepared

*Microscopical Examination*—Longitudinal sections of the transplant confirmed the gross examination In the transplant most of the lacunæ contained nuclei with normal staining properties In some areas the lacunæ contained no nuclear material Blood-vessels and connective had penetrated into many spaces in the transplant There was no evidence of regeneration of bone from any part of the graft At the junction of the transplant and the proximal stump of the resected ulna there was marked new bone formation This growing bone extended along the proximal third of the graft The sections examined did not show the small isolated island of new bone at the junction of the middle and distal thirds of the transplant All bone regeneration seen microscopically certainly originated in the stumps of the resected bone, and the growth was along the course of the graft and not from it

In the experiments in which living bone transplants without periosteum or endosteum were used there were very strikingly different results obtained from those experiments in which the periosteum and endosteum were not removed from the transplants In Experiments Nos 33, 39, and 42, in which the animals were sacrificed fourteen, twenty-one, and twenty-six days respectively after the transplantation, there was no evidence of any bone regeneration from the transplanted bone In Experiment No 46, in which the dog lived for seventy-eight days, there was a very small amount of new bone formed, which may have grown from the graft, but which seemed more likely to have originated from the stumps of the resected bone and grown along the course of the transplant In this experiment there was clearly a considerable amount of new bone which had originated in the stumps of the resected bone and grown along the course of the transplant In these experiments no old dog was used In all of the experiments there was abundant new bone formation from the femur in the region of the excision of

PLATE III

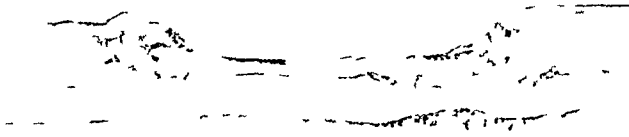


FIG 9 —Experiment No 46 Autotransplantation of living bone without periosteum or endosteum Seventy-eight days Showing the growth of bone along the transplant from the proximal fragment of the resected bone The small island of stained bone near the distal end of the graft may have originated in the transplant, but probably is a further extension of growth along the graft

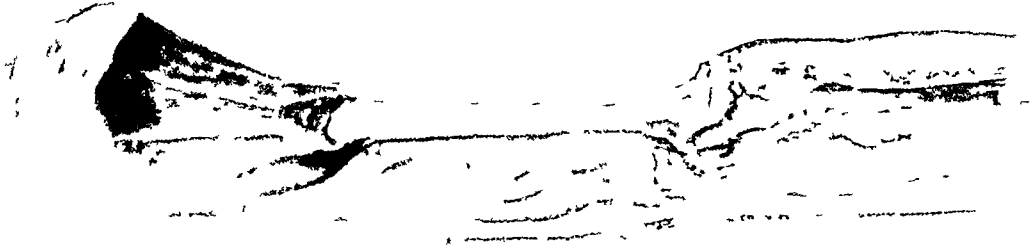


FIG 10 —Experiment No 37 Implantation of sterile dry bone Eighteen days Note the general staining of the bone in a young dog The island of red tissue between the implant and the radius is an area of calcification in degenerated muscle

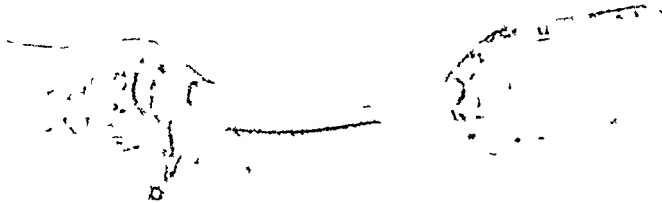


FIG 11 —Experiment No 47 Implantation of sterile dry bone Twenty-two days There is no growth of bone about the transplant



FIG 12 —Experiment No 49 Implantation of sterile dry bone Seventy-eight days Note the characteristic yellow opaque dead bone implant There is no new bone formed about the implant Microscopical section of this implant is illustrated in Fig 16, Plate IV



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the graft In Experiment No 33, there was a regeneration of a bridge of bone independent of the bone transplant This regeneration was probably from a small strip of periosteum along the attachment of the interosseous membrane which was not removed when the segment of the graft of the ulna was resected In Experiments Nos 42 and 46 microscopical examination of the transplant showed in parts of the transplanted bone that the lacunæ contained nuclei of normal staining properties In other areas the transplants were clearly nonviable In no experiment was there any evidence of regeneration of bone from the transplant

### III EXPERIMENTS WITH IMPLANTS OF STERILE DRY BONE

*Experiment No 37*—Young dog January 6, 1917 Implantation of dried sterile bone, eighteen days Incision in right foreleg 35 mm of shaft of ulna with periosteum removed Into the defect was placed a piece of dried sterile bone 40 mm long, 1 mm wide and 1 mm thick The ends of the implant were fixed in the medullary cavities of the stumps of the resected ulna Wound closed Plaster dressing

The wound healed *per primam* The animal was given on the seventh and fourteenth days an intraperitoneal injection of 3 c c of a saturated aqueous solution of sodium alizarine sulphonate

January 24, 1917, eighteen days Animal found dead The epiphysial cartilages were all present There was staining of all bones at the sites of growth There was new bone formation at the ends of the stumps of the resected bone The bone implant was not attached to the surrounding tissues There was no new bone formation along the implant In the connective tissue between the bone implant and the shaft of the radius there was a small red area (Fig 10, Plate III) Microscopical examination of this area showed it to be calcification in degenerated muscle fibres No microscopical examination of bone implant was made

*Experiment No 47*—Young dog January 15, 1917 Implantation of dried sterile bone, twenty-two days Incision in right foreleg 35 mm of the shaft of the ulna with the periosteum was removed A piece of sterile dry bone 40 mm long, 2 mm wide and 1 mm thick was placed in the defect in the resected ulna The ends of the bone implant were fixed in the medullary cavities of the stumps of the resected bone Wound closed Plaster dressing

The wound healed *per primam* The animal was given on the sixth and sixteenth days an intraperitoneal injection of 3 c c of a saturated aqueous solution of sodium alizarine sulphonate

February 6, 1917, twenty-two days Animal dead Cause of death was intestinal intussusception All the epiphysial cartilages were present There was staining of all bones at the sites of growth There was new bone formation from the ends of the fragments of the resected bone The bone implant was in good position There was no new bone formation along the implant The implanted bone was not attached to the surrounding tissues, but was firmly fixed in the medullary canals of the fragments of the ulna (Fig 11, Plate III)

*Experiment No 34*—Young dog December 7, 1917 Implantation of sterile dry bone, twenty-eight days Incision right foreleg 25 mm of shaft of ulna with periosteum removed Into the defect in the ulna was placed a piece of sterile dry bone, 40 mm long The ends of the implant were thrust into medullary canals of the stumps of the resected ulna Wound closed Plaster dressing

The wound healed *per primam* During the first two weeks of the experiment the animal was given on alternate days 2 c c of a saturated aqueous solution of sodium alizarine sulphonate subcutaneously During the last two weeks



of the experiment the animal was given two intraperitoneal injections of 4 cc of the saturated solution of the dye

January 4, 1917, twenty-eight days Animal dead The epiphysial cartilages were all present There was staining of the bones at the sites of growth There was well-stained new bone at the ends of the stumps of the resected ulna No color in or along the implant The implant was not attached to the surrounding tissues

*Experiment No 49*—Adult dog February 8, 1917 Implantation of sterile dry bone, seventy-eight days Incision in right foreleg 40 mm of shaft of ulna with periosteum excised A piece of sterile dry bone 40 mm long, 4 mm wide, and 2 mm thick was placed in the defect The ends of the implant were in contact with the stumps of the resected ulna Wound closed Plaster dressing The wound healed *per primam* The plaster dressing was removed at the end of four weeks The animal was given each week an intraperitoneal injection of 3 cc of a saturated solution of sodium alizarine sulphonate The animal remained in good health throughout the duration of the experiment

April 25, 1917, seventy-eight days Animal sacrificed There was very slight general staining of the bones The epiphysial cartilages had all disappeared The junction of the epiphysis and diaphysis at the lower end of the femur was distinct There was well-stained new bone formed from the stumps of the resected ulna There was subperiosteal new bone formation on the shaft of the radius in the region of the resection of the ulna The bone implant was in good position The ends of the implant were in contact with the stumps of the resected ulna There was motion with crepitus at each end The implant was surrounded by fibrous tissue There was no growth of bone along the implant (Fig 12, Plate III) Gross examination indicated definitely that the bone implant was nonviable, and there was no evidence whatsoever of new bone formation at any point along the graft Microscopical sections of the entire length of the transplant and the stumps of the resected ulna were prepared

*Microscopical Examination*—Sections of the transplant showed a very striking picture The lacunæ throughout the transplant contained nuclei with normal staining properties Blood-vessels and connective tissue had penetrated into the Haversian canals In fact, the microscopical picture of certain areas in the implant was that of normal living bone (Fig 16, Plate IV) The implant was surrounded by a dense connective tissue capsule which in the sections examined was in contact with bone implant in only a few places

There was regeneration of new bone from the stumps of the resected ulna This growth of new bone had extended along the course of the graft a short distance at the distal end of the transplant The ends of the transplant were separated from the ends of the stumps of the resected ulna by fibrocartilaginous tissue There was evident absorption of the implant by granulation tissue and giant-cells in certain areas, but on the whole the evidences of absorption were strikingly few

In these experiments in which pieces of sterile dry bone were implanted in defects in the shafts of bones there was in no instance any evidence that such an implant aided in any way the subsequent regeneration of the bone defect In no experiment was it found that the implanted dry bone induced new bone formation in the surrounding connective tissue, and there was no evidence that such implants had any specific powers of conducting bone growth from the ends of the stumps of the resected bone In Experiment No 49 it is possible that had the animal been allowed to live a much longer

PLATE IV



FIG 13—Experiment No 35. Auto-transplantation of living bone with periosteum and endosteum. Twenty-seven days. Photomicrograph of a longitudinal section of the periosteal surface of the transplant, showing the formation of new bone in the periosteum.



FIG 14—Experiment No 35. Auto-transplantation of living bone with periosteum and endosteum. Twenty-seven days. Photomicrograph of a longitudinal section of the endosteal surface of the transplant, showing new bone formation from the endosteum.



FIG 15—Experiment No 35. Auto-transplantation of living bone with periosteum and endosteum. Twenty-seven days. Photomicrograph of a portion of the transplant showing absorption of the bone matrix.



FIG 16—Experiment No 49. Implantation of a piece of sterile dry bone. Seventy-eight days. Photomicrograph of a portion of the implant showing a blood-vessel in a Haversian canal and nuclei with normal staining properties in the lacunae.



## STUDIES IN BONE REGENERATION

period the implant might have been slowly replaced by bone growing from the stumps of the resected ulna, but from other experimental work and clinical observations this seems improbable.

The microscopical examination of the implanted bone in Experiment No 49 is particularly interesting. The source of the implant and the gross examination at the end of the experiment showed clearly that it was necrotic bone. Microscopical examination, however, showed that blood-vessels had grown into the spaces in the bone matrix and connective tissue or phagocytic cells had permeated the lacunæ, resulting in the production of a microscopic picture which was indistinguishable in many areas from normal living bone. This finding indicates that microscopical examination may be often misleading in determining the viability of bone. In the microscopical examination of specimens from the implantation of pieces of dead bone into soft parts in other experiments not described in this paper it has been found that in the process of absorption of such implants a microscopical picture is produced which is often actually indistinguishable from that of new bone formation. This confusion between the microscopic pictures of bone regeneration and bone absorption, we believe, may be responsible for certain conflicting conclusions which have been reached by different investigators in problems of bone regeneration.

### DISCUSSION

These experiments show conclusively that a defect in the shafts of a bone may be quickly and completely regenerated after placing within the defect an autotransplant of living bone with periosteum and endosteum. The regeneration of bone to repair the defect originates in portions of the normal bone regenerating elements of the graft which remain viable. There is a question whether the transplanted bone matrix and bone cells retain their viability for a short period of time, but there is no question that the identity of the transplanted bone is ultimately lost as a result of absorption and replacement by new bone. If the periosteum and endosteum together with the adjacent layers of bone are removed from the transplant, it has no osteogenetic properties. Such a transplant may show microscopic evidence of remaining in part viable, but this evidence is uncertain. If an implant of sterile dry bone is placed in a defect in the shaft of a bone there is no evidence that such an implant aids in any way the regeneration of the defect. The implanted dead bone neither results in a metaplastic production of bone from the surrounding tissue nor does it possess any specific property of conducting bone growth across the defect in the bone shaft. These facts clearly indicate that the living bone transplant with the periosteum and endosteum is the only type of implant which has osteogenetic properties. It is possible that a defect in the shaft of a bone may be regenerated by the growth of bone along the course of a transplant when the transplant itself has no osteogenetic properties, but this is a relatively

slow process, and it will take place only in case the defect is small and there is active bone regeneration in the fragments of the bone shaft in which the defect occurs. The osteogenetic properties of a free bone transplant vary quantitatively with the potential osteogenetic properties of the bone from which the transplant is taken. In this experimental work the factor which seemed to influence the power of bones to regenerate was the age of the experimental animal. Clinical experience shows that there are other factors.

We believe it is no longer a matter of question that the preservation of the periosteum and endosteum on a free bone transplant is the most important factor in determining the success of the transplant. The explanation of this fact is not yet clear. The following three explanations have been given: (1) The periosteum serves to direct and protect new bone growth. (2) The periosteum aids in securing early nourishment for the transplant. (3) The periosteum is the osteogenetic element of the bone transplant.

The first two explanations are based on the assumption that osteogenesis originates in the bone cells of the cortical bone. We believe that the greater weight of experimental evidence is to the contrary. It is interesting, however, that in experiments in which free transplants of periosteum alone have been used there has been regeneration of bone in a relatively small proportion of instances. It seems therefore that the osteogenetic power of the free bone transplant depends on the preservation of the normal relation of the different elements of the transplant. In other words, osteogenesis is from the junction of the periosteum and cortical bone rather than from either alone. The same statements which have been made concerning the periosteum apply to the endosteum.

The influence of "functional demand" on the survival and growth of the free bone transplant is a subject which deserves brief comment. In all experiments described in this paper the transplants were placed in sites where bone is normally present. It has been found in other experiments in which transplants of bone with periosteum and endosteum have been placed in sites in which bone is not normally present, that the transplant first shows evidence of bone regeneration, but later this regeneration ceases and ultimately the transplant is completely absorbed. These facts indicate that there are both external and internal factors which determine the regeneration and growth of bone from a free bone transplant. The power of a free bone transplant with periosteum and endosteum to regenerate bone is an intrinsic property. The ability of the regenerating bone to continue the production of new bone until a functioning bone is completed is determined by external influences. The term "functional demand" may be applied to the combination of the external influences.

The practical application of the observations in this experimental study is so obvious that it requires little comment. The free bone transplant with the periosteum and endosteum is certainly the only type of implant which may be expected to be the source of new bone formation. An implant of

sterile dry bone or a transplant of living bone without periosteum or endosteum may be used as a means of fixation, or, in cases of small defects in bone, such an implant may ultimately accomplish the desired result of regeneration of the defect by being absorbed and replaced by new bone which originates from the bone adjacent to the implant. This result will not be accomplished in case the defect is large or the adjacent bone has little osteogenetic power. The osteogenetic power of a free bone transplant varies with the age of the individual, and general constitutional condition. The results of bone transplantation in children are more likely to be good than in cases of old or poorly nourished individuals.

The fact that in clinical surgery the necessity often arises of bridging a bone defect in a patient in which there is evidence of little power of bone regeneration suggests the possibility of devising means for increasing the osteogenetic power of the transplant. Two possibilities have seemed to be worth investigating experimentally. These are as follows: 1. The possibility of using a transplant from another individual in which there is greater potential power of osteogenesis. 2. The possibility that the osteogenetic power of the graft may be increased by causing artificial injury to the bone from which the graft is to be taken and thus causing new bone formation and subsequently transplanting the growing bone.

Experiments are now in progress to determine the value of these methods.

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# THE COMPLETE MASTOID OPERATION\*

ITS RELATION TO THE MODERN HEALING OF MASTOID WOUNDS

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THE procedure about to be described as the complete mastoid operation has been performed by the writer upon some 113 patients. My purpose in using this technic with its associated after-treatment is

1 To prevent as much as possible the development of those serious intracranial and other complications which sometimes follow an inflammation of the mastoid or an operation for its relief

2 To reduce the time required for the healing of the mastoid wound

3 To render the dressing as painless as possible

4 To improve the appearance of the healed wound

In order to satisfy these four postulates and estimate the true value of an additional step in the technic of such an orthodox procedure as the simple mastoid operation, it is necessary (1) that the surgeon should employ this technic in a large number of operations, and (2) he should observe in a general way the post-operative course of at least an equal number of patients operated upon and treated according to other methods

The cases upon which this paper is based are not selected ones. With few exceptions, they represent the total number of mastoidectomies performed by the author in the past few years. Practically all the operations took place at the New York Eye and Ear Infirmary or at the Manhattan Eye, Ear, and Throat Hospital.

Of these 113 patients, one developed sinus thrombosis on the seventh day of convalescence, and was successfully operated upon. In 23, well-marked perisinus or epidural abscess was present, all recovered. Subperiosteal abscess was present in 18 cases. Two patients developed erysipelas during convalescence—one a man and the other a woman, this complication appearing on the tenth and nineteenth days respectively. Streptococcus was the infective agent most commonly found, being present in 48 cases, seven were of the capsulatus variety, one patient died. One patient, an alcoholic, died of delirium tremens. Three patients of the 113 developed post-operative meningitis of otitic origin, and died. The first symptoms of this fatal complication appeared in these three cases on the second, third, and tenth days of convalescence, respectively. In one of these fatal cases neither sinus nor dura was exposed, the infecting organism in this instance being the streptococcus capsulatus.

Dura covering the sinus or brain was exposed in 46 of these operations. There was a total of four deaths in these 113 cases, one of which bore no

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\*Read before the American Laryngological, Rhinological, and Otological Society, June 1, 1917

relation to the mastoid disease. In regarding this mortality, it must be remembered that these patients practically represent successive cases, many of which were brought to the hospital in advanced stages of mastoid disease. The three cases of meningitis occurred in young male adults, one of whom had a subperiosteal abscess of several weeks' standing containing gas. In the other two fatal cases, the mastoiditis was produced by an encapsulated organism, one a streptococcus and the other a pneumococcus. One of these patients, prior to the operation, developed symptoms of what might have been a beginning meningitis.

The usual time required for the complete healing of the wounds varied from three to five weeks. A number of cases healed in less than this time, some requiring slightly over this period. Owing to the light packing of the mastoid wound, the dressings are much less painful than is usually the case. After the healing, the wound presents little if any deformity, the depression being scarcely noticeable.

*Operative Technic*—In making the incision for this operation, it is necessary to curve the upper extremity until it is directed horizontally forward, terminating in a point about one-eighth of an inch above and in front of the superior attachment of the auricle. (See Fig 1.) This incision is usually carried through the lower edge of the temporal muscle along the line of the external wound. The cut in the muscle is on the bias of its fibres and is between one-eighth and one-fourth of an inch in depth. Anterior to this cut, the external surface of the temporal fascia is free from the auricle. The underlying periosteum is elevated. On retracting the soft parts, there is a wide and free exposure of the entire zygomatic region. These preliminaries are essential to the free exposure and curettement of the attic region. I have never found that this incision into the temporal muscle resulted in its infection or in any impairment of its function.

The bony mastoid cortex and subcortical cells are then removed, together with the tip and the cells over the knee of the sinus, the antrum is opened and curetted; the zygomatic cells are removed, and the cap of the external semicircular canal is exposed. All gross evidence of disease having been removed from the mastoid, the operator is ready for the third stage, namely, the curettement of the attic of the middle ear (see Fig 2).

At this point, it may be well to review the surgical anatomy of the epitympanic region. The attic of the tympanum is that portion of the middle ear cavity which lies above the level of the tympanic membrane. It contains the head of the malleus and the greater part of the incus. These two ossicles articulate in about the middle of the attic. Running upward from the head of the malleus to the vault of the attic is the superior ligament of the hammer, and proceeding forward from the neck is the anterior ligament. The malleo-incudal body, with the superior and anterior ligaments of the malleus, divide the epitympanum, surgically, into two cavities—the internal attic, lying internally to these structures, and the external attic, lying externally. The external attic is still further subdivided by the



external lateral ligament of the malleus into Prussak's space, which lies below, and a much larger space above, the external attic proper, with which we are now concerned

When curetting the attic of the tympanum, the external attic should first be cleared out and the malleo-incudal body exposed, after which the internal attic may be safely curetted. In curetting the external attic, a small narrow Spratt curette is passed from the antrum directly forward until the spoon rests immediately behind the bony external attic wall. The long axis of the curette should be passed parallel to the same plane as the external semicircular canal and held slightly above it (Fig 2). By observing these precautions, we insure the entrance of the instrument into the external and not the internal attic. The short process of the incus lies directly below and external to the spoon, and by keeping the edge of the curette in close apposition to the bony external attic wall there is no danger of disturbing the malleo-incudal body lying slightly in front and internal to the back of the curette.

The external wall of the attic is then removed by curetting directly outward, the direction of motion being still in the same plane as the external semicircular canal. The posterior bony canal wall is lowered to within about one-quarter of an inch of the membrana tympani, and is reduced in thickness. The short process of the incus should then be visible. It is commonly found embedded in granulation tissue, but is always just below and anterior to the cap of the external semicircular canal, resting in the fossa incudis (see Fig 3).

We now continue to remove the external attic wall by curetting in the aforesaid manner until the body of the incus and the head of the malleus is exposed (Fig 4). In fact, in the latter stage of this portion of the operation, the curette has been in contact with the anterior wall of the attic.

With the attic thoroughly exposed and the malleo-incudal body freely visible, it is a simple matter to curette the internal attic. In all the cases of mastoiditis that I have operated upon, I have never failed to find the attic region filled with granulation tissue.

*Post-operative Care and Dressing*—Usually, at the conclusion of the operation, an iodoform gauze drain (from four to six inches long and one inch wide, doubled once) is laid down to the antrum region, more recently, plain sterile gauze has been employed, giving somewhat better drainage. The external auditory canal is packed snugly with a narrow strip of plain gauze dipped in saline solution. The posterior wound is sutured from above down to within the last half or three-quarters of an inch, and a copious wet saline dressing is applied externally. This is continued for the first week or ten days, after which a dry dressing is used. Boric acid ointment or vaseline applied to the auricle and adjacent skin prevents maceration of the cutaneous surface. Daily dressings are performed until the wound has almost healed. This usually takes place within three to five weeks from the time of operation. Half of the sutures are removed on the first day after the operation, and the remainder on the second day. The canal is packed

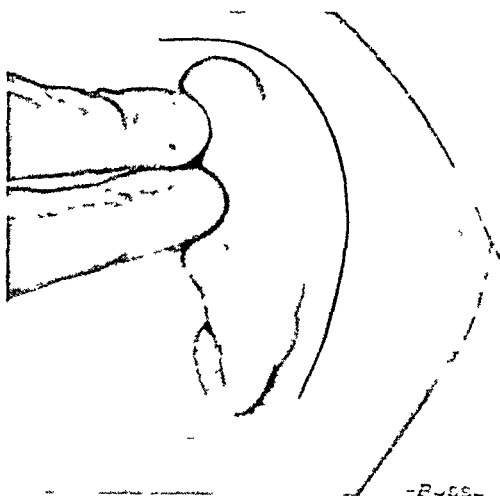


FIG 1 —The primary incision. Its upper extremity is directed horizontally forward

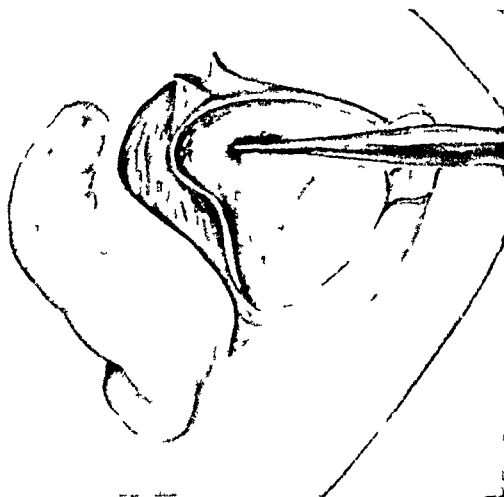


FIG 2 —Appearance of wound at the conclusion of the simple mastoid operation. Curette in position about to remove the external attic wall. The horizontal semicircular canal is visible just below and parallel to the narrow extremity of instrument shank

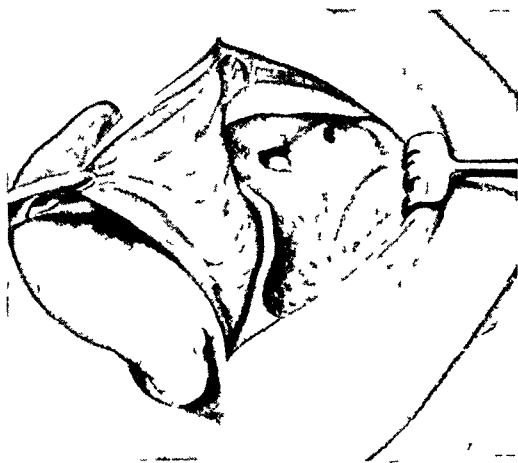


FIG 3 —The external attic wall partially removed, revealing the body and short process of the incus lying in the "fossa incudis" just below and anterior to the prominence cap of the horizontal semicircular canal

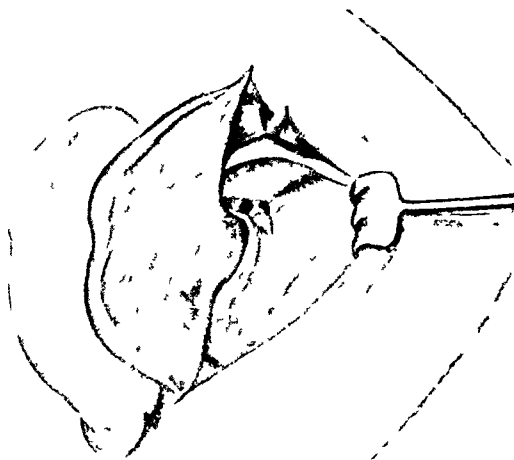


FIG 4 —Appearance of wound at the conclusion of a complete mastoidectomy. The external attic wall has been removed, the head of the malleus with its superior ligament can be seen anterior and internal to the incus. The internal and external attic spaces lie respectively on the inner and outer sides of the malleo-incudal body



## THE COMPLETE MASTOID OPERATION

snugly at each dressing, and the posterior gauze drain is usually discontinued between the fourteenth and the twenty-eighth day. Owing to the small amount of packing used in the mastoid wound, the dressings are comparatively painless. After healing has taken place the amount of post-aural depression is usually very slight,—in fact, hardly noticeable.

The functional results have been in every way satisfactory. So far as known, none of the patients has had to undergo operation for recurrent mastoiditis.

The writer wishes to emphasize the importance of packing the wound lightly, particularly the antrum region. Gauze packed tightly in the mastoid wound not only results in insufficient drainage therefrom, but is, in the author's opinion, the most common cause of delayed healing and depressed cicatrices. This is especially true in cases where a thorough operation has been performed.

A striking feature of the post-operative course of these patients is the rapidity with which a long-continued and profuse middle ear discharge ceases. The external auditory canal usually becomes dry on the second day. My own belief is that the failure to curette the attic region is frequently the cause of the persistent otorrhœa which sometimes follows a simple mastoidectomy.

### CONCLUSIONS

1 It is the writer's conviction that in order to satisfy the requirements of his four premises it is necessary to perform all mastoidectomies as thoroughly as possible.

2 He believes that the exposure and curettement of the attic region has a direct beneficial bearing on the post-operative course of these patients.

3 That light packing of the wound, using only sufficient gauze for drainage, together with daily dressings, is essential in obtaining a satisfactory result.

4 In respect to the painful dressing, slow healing, and frequent poor cosmetic appearance, the simple mastoid operation is one of the most unprogressive of modern major surgical procedures, and any technic which promises to safely modify these distressing factors of convalescence deserves the serious consideration of otologists.

# DISLOCATION OF THE CERVICAL VERTEBRÆ

REPORT OF TWO INSTANCES COMPLETELY REDUCED MANUALLY WITHOUT ANÆSTHESIA

BY KELLOGG SPEED, M D

OF CHICAGO

MAJOR, M O R C , U S ARMY, ON ACTIVE SERVICE

CASE I —H F, Lance Corporal in the First Dorsets, thirty years old On July 10, 1916, while sitting on the edge of a trench, was plunged headlong into the trench by a nearby concussion He struck on the left side of his head and left shoulder As near as he could recall, his head was twisted to the right He was buried in the debris of the explosion for some hours and at first, after being dug out, he could not move his legs After two hours, however, motion returned and he was later able to walk

On July 12, 1916, he was admitted to my service at the Twenty-third General Hospital, British Expeditionary Force, as an ambulatory patient, holding his head stiffly, chin toward the right shoulder (see Fig 1) There was complaint of some headache, but no pain in the arms or legs, no paralyses and no evidence of involvement of the cranial nerves Recognizing the serious character of the injury, I ordered him to bed at once Pain radiating down the left shoulder and arm developed later and was constant After a day a skiagram was made in both anteroposterior and lateral planes and there was proven a dislocation of the fifth cervical vertebra, rotatory in type, the left side having moved forward, the right side slightly backward Beneath the angle of the jaw and behind and beneath the left sternocleidomastoid muscle could be felt the bony mass of the forward displacement On the right side there was no distinct finding of bony deformity The skiagram was not quite definite enough to establish the fact of fracture of any part of the vertebræ in this region, but it was suspected Pharyngeal examination with the index finger demonstrated a bulging on the left posterior wall, evidently bony, and about the level of the fifth cervical (see Fig 2)

We had no leather traction harness and as no improvement followed rest flat in bed with injunction to the patient not to turn the head, I decided to attempt manual reduction On July 18, the deformity seeming to have slightly increased, I tried reduction Placing the patient in a sitting position in bed, grasping the head beneath the occiput and chin, I was enabled, by forcible extension which nearly lifted his whole body weight, to make rotation and correct the deformity A very slight jar was perceptible After gently relaxing my grasp, I was surprised to see the head slowly but surely return to its former deformed position, without any snapping sound or subjective sensation, and without increased pain Some new pain did develop down the middle of the back, but no untoward symptoms appeared

A great rush of work followed this reduction and I was unable to perform anything in the line of a permanent treatment until August



FIG 1—Dislocation of fifth cervical vertebra. Note bony mass beneath sternocleidomastoid muscle and rigidity of neck



FIG 2—Back view of same patient as Fig 1. Notice the tilting of the head and absence of prominence in right side of neck



FIG 3—Same patient as Fig 1, enclosed in plaster helmet, deformity corrected, head in slight extension



FIG. 4 —The second patient. Note the bony deformity beneath the right side of the neck, the tilted, rigid head and the direction in which the chin points. The head in this instance is inclined to the left the chin points toward the left shoulder away from the unilateral right-sided dislocation.



FIG. 5 —Side view of the preceding, showing the angle at which the head was stiffly held.

15. Although I twice repeated the manual reduction and observed the same swinging back into deformity without disaster, it was not until a month after the first reduction that we were enabled to apply a plaster-of-Paris encasement to hold the head in a slightly over-corrected position with some extension. The jacket applied (see Fig 3) was rather heavy but served its purpose well, being anchored firmly on the padded shoulder and chest. When it was thoroughly dried, it became so light that he was able to get up and walk about. Shoulder and neck pain became greatly lessened within forty-eight hours and then disappeared. The pharyngeal displacement became corrected and I was unable to obtain a post-reductive skiagram on account of the thickness of the plaster and the lack of penetration power of our X-ray. Because all symptoms improved, the man was sent to England in the case some time later and I have been unable to follow the ultimate outcome.

CASE II—Miss G, nineteen years old, a nurse in active training, on awakening early one morning, twisted her head to the left and used her left arm to reach under the pillow for her watch. There was some sudden pain down into the left side of the neck and shoulder and she found that her head was held rigidly turned thus (see Fig 4). No other symptoms were present. Later pain developed in the distribution of the second, third and fourth cervical nerves, also down into the right arm.

A skiagram demonstrated the suspected rotatory dislocation displacement of the third cervical forward on the right side, unilateral in character. Pharyngeal examination was negative, no fracture could be discovered and there was bony projecting deformity to be felt beneath the right sternocleidomastoid, pressure on which was painful. I made an attempt at manual reduction in this instance also within twenty-four hours, the patient sitting on a low stool. By the same manoeuvre of traction on occiput and chin, followed by rotation during its maintenance, I was able to establish a complete reduction without palpable jar. The head was then moved over into a slightly over-corrected position and a similar plaster dressing was applied. After it was dry the patient was allowed to go to her home in another state.

Four weeks later she returned, the case was removed, and immediately she was able to move the head and neck freely without pain or recurrence of deformity. She is now at work with no evidence of the injury.

Instances of cervical fracture-dislocation are not rare, but those which have occurred without serious symptoms and have been reduced by manipulation, especially without anæsthesia, are so uncommon that they should be recorded. The neck, above the vertebra prominens, requires more mobility for functional use than any other part of the spine. This mobility is secured with some sacrifice to safety because to procure the latitude of motion the vertebral articular surfaces are less oblique and are directed slightly downward, outward and forward. One must also remember that there are no steadying ribs in the neck, and, because the lax ligaments permit head rotation of at least 30 degrees on either side of the centre line, much



of the neck's rigidity and safeguarding of the spine's integrity depends on constant tonic muscular action. Sudden blows and jars will account therefore for most of these dislocations, but muscular action alone may be the cause, as in the second instance recited here. If violence is applied when the muscles are not tensely on guard, the other factors mentioned permit the "flying start" mechanism so well described by Corner (*ANNALS OF SURGERY*, xlv, 9). A unilateral and backward dislocation caused by the rough manipulation of an osteopath was reported by Jonas (*Trans Amer Surg Assoc*, xxxiv, 34-466).

Five instances of *total* lower cervical dislocations were recorded by Quetsch (*Munch med Wchnschr*, 1912, No 18, S 180). Four of these were forward about the level of the fifth and sixth cervical, one was posterior. Two had hæmatomyelia with recovery. Partial or unilateral dislocations are more commonly observed and of course offer a better prognosis. Griffith (*Amer Jour Orthop Surg*, vol xii, 332) described three instances, one of which reduced itself under morphia. The other two were successfully restored to normal by manipulation. In the discussion of his paper, six additional instances were brought to light.

Prognosis must be governed by the pathology present, *i e*, by the degree and direction of direct displacement, the support afforded after displacement has taken place and the subsequent progressive condition. Unilateral displacement forward without serious cord symptoms offers reasonable hope of complete reduction and restoration to normal. One must not overlook *delayed* symptoms following hæmatomyelia or spondylitis. In the twenty instances studied by Corner, two atlas dislocations were immediately fatal and none of the remainder presented symptoms *at first*. Cord symptoms may develop after varying periods from a few days to a year or more, depending on progressive pathology or subsequent dislocation dependent on the primary injury. Wilson mentioned (*ANNALS OF SURG*, xlv, 632) a brakeman who fell from a train, suffered a fracture-dislocation of the atlas without symptoms of cord injury, and worked quite steadily for a year afterward. He was first seen and examined three years after the accident, pain in the head and neck having caused him to discontinue work after one year. There was considerable spondylitis present and the axis was found well tilted forward but there were no cord symptoms. It was supposed that this man had suffered a primary dislocation with an instantaneous reduction and that the subsequent spondylitis had induced a secondary partial dislocation. Ryerson (*Amer Jour Orth Surg*, 1910, 342) obtained a reduction for his patient by anæsthesia and manipulation, the third cervical having been dislocated on the fourth. One instance of subluxation of the atlas on the axis, possibly similar in mechanism to the second one mentioned here, was caused by the act of pitching a baseball. Ogilvy (*Amer Jour Orth Surg*, xii, 314) saw the patient a month later but was unable to obtain reduction with the aid of anæsthesia. Eccles reported last year (*St Barth Hosp J*, London, xxiii, 101) two instances of cervical dislocation without death.

## DISLOCATION OF THE CERVICAL VERTEBRÆ

When reduction is not possible with or without anæsthesia, recourse may be had to laminectomy for pressure pains on the nerve roots Rochfort (*Boston M and S Journal*, clxxiv, 469) performed this operation after dislocation of the second cervical

Briefly the symptoms and diagnosis may follow the history of a blow or violence applied to the head or a sudden muscular action involving the head and neck generally without symptoms of paralysis or anæsthesia (cord involvement) in the unilateral rotatory displacements The neck at or about the point of displacement is painful to palpation, it is held stiffly and head can be moved little Some motion is generally possible unless the dislocation is total—the deformity also going hand in hand with the relative amount of displacement As in Fig 1 the head is usually flexed and turned to one side and in severer displacements it is bent toward the shoulder except when the displacement is posterior The chin as a rule points toward the side *away* from the inclination of the head and the head can be rotated more to that side than the other We know that the side toward which the chin is directed is that on which the transverse process of the cervical vertebra is either intact or is displaced backward Attempts to rotate the head soon discover to which side it cannot be turned and it is on this side that the dislocation, partial or complete, has occurred The articulation of the joint on this side has become fixed by the displacement and rotatory muscular action If the head is extremely rigid and will not permit motion more in one direction than another—all movements of course being attempted with the greatest caution—we must diagnose a bilateral displacement Bony prominence in the neck is usually on the dislocated side Pharyngeal examination along the posterior wall when the mouth can be opened confirms the other findings Lateral skiagrams are absolutely necessary to arrive at a complete rontgenologic diagnosis

In uncomplicated unilateral cervical dislocation displacements, I wish to advise a careful attempt at reduction without anæsthesia, with cooperation of the patient to enable the operator to observe the onset of untoward symptoms A complete helmet case should be installed for from four to six weeks to insure ligamentous healing before the head is entrusted to its own musculature again

# TUBERCULOSIS OF THE APPENDIX

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(From the Pathological Laboratory of the Army Medical Museum)

TUBERCULOSIS of the appendix is one of the more rare manifestations of tuberculosis in the human body. Since the recognition of the disease by Corbin<sup>1</sup> in 1873, it has only occasionally attracted the attention of the physician and surgeon. With the discovery of the tubercle bacillus by Koch in 1882, added zest was given to the study of tuberculous lesions in general, and in the last few years tuberculosis of the appendix has been accorded greater attention. However, the comparative rarity of the condition is indicated by the fact that the Index Catalogue of the Surgeon General's Library and the Index Medicus present but forty-four articles upon this subject, nine of which the physicians of the United States have contributed. This fact stands in marked contrast to the thousands of papers which have been written upon the general subject of appendicitis. The larger text-books on pathology and even the extensive systems of medicine and surgery accord only passing mention to the lesion or entirely neglect it.

While the opinions of different medical writers vary somewhat as to the frequency of the disease, all are agreed that it is relatively infrequent. Deaver, of Philadelphia, considers it among the greatest rarities, while Lockwood, of England, considers that two per cent of all diseased appendices are tuberculous. In the Montreal General Hospital in a series of 1259 appendicectomies, there were found but three appendices showing tuberculous involvement, giving a percentage of but 0.16. In Allen's<sup>2</sup> series of 80 cases, tuberculosis was twice noted. In my series of 179 appendices studied histologically, only one case was discovered. The frequency of tuberculosis in appendices removed by operative procedure is much less than that in appendices removed at post-mortem examinations, as may be seen by a reference to Tables I and II.

TABLE I

FREQUENCY OF TUBERCULOSIS OF APPENDIX FOUND AT OPERATION

Operator	Year	Operations	Tuberculous	Per cent
Fitz	1886	257	8	3.0
Robson	1902	300	5	1.7
Letulle	1905	300	2	0.7
Mayo	1905	1888	29	1.5
Surg. Lab., U. Penn.	1909	310	6	2.0
Deaver		7610	16	
Allen	1909	89	2	2.8
Author's series	1917	179	1	0.57

<sup>1</sup> Muller Univ. Penn. Med. Bull., 1909-1910, xxii, 48-54

<sup>2</sup> Allen Brit. J. Child Dis., 1909, vi, 1-7

# TUBERCULOSIS OF THE APPENDIX

## TABLE II

FREQUENCY OF TUBERCULOSIS OF APPENDIX FOUND POST-MORTEM

Operator	Autopsies	Tuberculous	Per cent
Fenwick and Dodwell	2000	17	0.8*
Leseur	500	144	22.0
Kelly	3770	44	1.2
White (cases dying in Phipps Institute as probably tuberculous)	263	57	21.7
White (cases dying in Phipps Institute as probably tuberculous)	56	33	59.0†

\*Primary tuberculosis of the appendix

†Examined microscopically

The disease is more common in males than in females, the ratio being as three is to two. Most of the cases found in the literature have occurred in young adults. The following table from a paper by Muller shows the age incidence.

## TABLE III

AGE INCIDENCE

Years	Cases
2 to 9	3*
10 to 19	18
20 to 29	21
30 to 39	16
40 to 49	6†

\*The earliest recorded case occurred in a child of two years

†The oldest recorded case occurred in a man of 47 years

The disease occurs in two forms, primary and secondary. The primary form of the disease is very rare. The existence of the primary form has been denied by many writers, but Beck<sup>3</sup> reported a case where the removal of a tuberculous appendix was followed by death of the patient. An autopsy was performed and absolutely no evidence of tuberculosis was found elsewhere in the body, except in the lymphatic nodes of the ileocaecal angle, which were of a decidedly recent origin and were held to be secondary to the appendiceal lesion. The primary form of the disease may originate through (1) the deposition of the bacilli from the contents of the intestinal tract itself, (2) from the peritoneum, (3) from the lymphatic system, and (4) from the circulating blood. Deposition of bacilli from the faecal content of the intestinal canal itself seems to most observers to be the most rational conception of the etiology of the primary form, since it would be extremely rare for bacilli free in the peritoneal cavity or in the general lymphatic or blood circulation to elect the appendix alone as a seat of infection, while sparing other equally vulnerable organs. The dependant position of the appendix with its tendency toward faecal stasis affords the bacilli in the faeces a favorable opportunity for becoming implanted and developed, and hence favors the theory of an intestinal origin of the disease.

<sup>3</sup> Beck Volkmann's Vortrage, 1898, No. 221

The secondary form of the disease is much more common. It may arise by the direct extension of the process from adjacent tuberculous structures. The most frequent point of extension is from an adjacent ileo-cæcal tuberculosis. Direct extension may also occur when the appendix becomes adherent to tuberculous adnexa in the female. By means of the blood stream, the appendix may become infected from a focus in a distant organ, especially from a pulmonary focus. It is even asserted that the appendix may be invaded thus by bacilli from a pulmonary focus, while the intestinal tract itself entirely escapes.

Tuberculosis of the appendix occurs in one of three types, miliary, ulcerative, and hyperplastic. In the miliary type, the disease is usually manifested in the form of miliary tubercles on the peritoneal covering of the appendix. The majority of such cases appear as a part of a generalized or localized peritoneal tuberculosis, and should not strictly be classed as appendiceal lesions. Of course, it is possible that bacilli might penetrate from the faecal content of the lumen, permeate the walls and develop nodules on the peritoneal surface, but in such cases there would be great likelihood of the development of the ulcerative form in the mucosa and submucosa.

The ulcerative type is the most common form. It may be primary, but usually is secondary to either ileo-cæcal involvement or tuberculous lesions of the lungs. Often it is not recognized before the microscopic examination of the excised organ is undertaken. The appendix is somewhat thicker than the normal organ. The serous coat is usually injected and frequently presents very fine adhesions. At times, however, one finds small grayish-white tubercles on the serosa. The mucosa is injected and presents small round or oval ulcers of varying extent. These ulcers may show minute tubercles in the floor, or the floor may be caseous. The ulcers are most often found near the tip of the organ, next in frequency at the base, while the intermediate portion most frequently escapes. These points of localization correspond to the points of greatest liability to faecal stasis. The ulcers extend through the mucosa into the submucosa. At times the floor of such an ulcer is formed by the muscular coat. Perforation of the appendix is rare, but occasionally a ruptured tubercle on the serosa becomes the point of origin for a peri-appendicular abscess. Microscopically, the characteristic lesions of this type are confined to the mucosa and the submucosa. Here endothelial leucocytes and giant cells occur, with greater or lesser caseous destruction of the mucosa. Simultaneously the meso-appendix may show miliary tubercles and the adjacent lymph-nodes may be involved.

The hyperplastic type is usually secondary, there being but two cases reported in which the disease was primary. The appendix is usually somewhat enlarged, the thickening of the walls being accompanied by the deposit of fibro-adipose tissue beneath the serosa. The thickening involves the entire circumference of the organ and merges gradually with the normal areas. At times cicatricial contractions and adhesions cause a narrowing or even a stenosis of the lumen. The serosa is unchanged, but through it

one may see the discolored areas in which the subserous tissues have degenerated or become the seat of hemorrhage. Rarely miliary tubercles are found on the serosa. The mucosa is usually slightly involved, but may present a few tubercles or a few ulcers. The chief alteration occurs in the submucosa, which is greatly thickened and presents numerous tubercles in all stages of development and degeneration. There is a predominance of fibrous connective tissue and the process extends through the muscular layers in such a manner that often the separate tissue layers become indistinguishable. Microscopically, one sees a great increase in connective tissue, a blending of the layers, giant cells, fewer endothelial leucocytes, and less caseation than in the usual tubercle. By appropriate staining methods, tubercle bacilli may usually be demonstrated. The development of the hyperplastic form is considered to be due to the fact that the patient possessed a high index of resistance, whereby reparative or restrictive processes are developed around the tuberculous lesion, resulting in fibrosis. Likewise the absence of the high index of resistance results in little protective mechanism being developed, with the formation of the more rapidly destructive type of the disease.

The signs and symptoms of tuberculous involvement of the appendix show considerable variation in different patients. They fall into two groups, (1) Those referable to the tuberculous process as a pathological entity, and (2) those referable to the appendix itself. The general symptoms include the characteristic temperature of tuberculosis, usually rising two to three degrees during the afternoon, falling during the night to normal or nearly so in the morning. In some cases, there are no marked temperature changes, except during the exacerbations of the disease. In the majority of cases the pulse is somewhat accelerated. As in tuberculosis in other parts of the body, so in tuberculous appendicitis we usually find slight but progressive loss of weight. Nocturnal sweating occurs, but less frequently than in pulmonary involvement. The appendiceal disease is characterized by its extreme chronicity, which may frequently be interrupted by acute exacerbations. The appendiceal symptoms in the intervals between exacerbations present a vague sense of discomfort in the iliac fossa with slight tenderness. During the acute attacks, nausea and vomiting may occur. There may be marked muscular rigidity in the right lower quadrant. There may be slight meteorism. The characteristic point in tuberculous appendicitis is a history of recurrent attacks of appendiceal colic in which the distress of the patient is much less than is ordinarily found in acute appendicitis. Occasionally in individuals possessing rather thin abdominal walls, the appendix may be palpated as a thickened fibrous cord, at other times an irregular hardened mass is found in the region of the ileocaecal junction. In cases where the appendix is secondarily involved, the symptoms due to the primary focus will also be evident.

The clinical diagnosis of the disease is difficult, and most diagnoses have been made during operation, at autopsy, or on the microscopical examination of the organ after its removal. The presence of a history of "chronic

appendicitis," associated with a slowly progressive loss of weight, afternoon temperature and nocturnal sweating should suggest the possibility of this condition. Blood examinations during the acute attacks are of relatively slight value, as there may be either a leucocytosis or a leucopænia. If there is mixed infection superimposed, there may be leucocytosis. In uncomplicated tuberculosis there may be leucopænia. Bloodgood has remarked that in chronic cases without the active formation of pus, the leucocyte count generally lies below normal. This has been disputed by other observers, but the general opinion is that the white count is never very high in uncomplicated tuberculous appendicitis. The use of tuberculins has proven of no assistance in reaching a diagnosis. The finding of tubercle bacilli in the fæces would be of some assistance, provided one could exclude the possibility of swallowing tuberculous sputum and the presence of intestinal tuberculosis.

Clinically the question of a differential diagnosis rarely arises, since tuberculosis of the appendix seldom enters the mind of the physician at this time. In chronic cases, tuberculosis would be separated from chronic non-tuberculous involvement by the greater chronicity, the presence of an afternoon rise in temperature, loss of weight, and lesser degrees of prostration. It is recognized from suppurative appendicitis by the mildness of the attacks, absence of leucocytosis, absence of sustained hyperpyrexia, and by the lesser degree of fixation of abdominal muscles. At operation, it is differentiated from neoplasm by the fact that the tuberculous enlargement of the organ merges gradually with the neighboring healthy tissue, while a neoplasm is more localized and the transition from the pathological to the normal tissue is abrupt and demonstrable to the eye and finger.

The disease may be complicated by a peri-appendicular abscess, caused by the proliferation of the colon bacillus through the appendiceal walls. The rupture or the perforation of the ulcerative type may result in a peri-appendicular abscess of the form known as "cold abscess." A more common complication is the finding of a generalized tuberculous peritonitis, in which case care must be exercised to determine whether the appendiceal lesion is secondary to the peritonitis. Ileocæcal tuberculosis is often found in connection with this disease. It is usually secondary to the appendiceal lesion, rather less frequently the appendiceal lesion is secondary to the ileocæcal process. In advanced cases the mesenteric and ileocæcal glands may be involved.

The prognosis in tuberculous appendicitis varies according to the variety of the disease and the complications that are present. The operative mortality is very small, although the final results are not entirely favorable. In 66 cases collected by Muller, one death resulted directly from the operation, while 15 others died within a few months following operations. In fact, but 8 cases are definitely reported in the literature as cured. A cure should not be assumed until two or three years have passed following the operation. If the disease is primary in the appendix and if the operation is done before secondary involvement occurs, the operation should offer

## TUBERCULOSIS OF THE APPENDIX

strong hope of complete cure Secondary tuberculosis of the appendix offers a very dismal prognosis When the process is secondary to pulmonary involvement, especially with coincident intestinal lesions, the prognosis is grave The prognosis is somewhat more favorable in the hyperplastic type of the disease

The treatment falls into two subdivisions, medical and surgical Medical treatment is permissible only in secondary type of the disease, and then only in cases where the general disease is active and progressive If the general disease is quiescent, operative measures should always be undertaken The condition of the lungs should be made the criterion by which the advisability of the operation is decided Advanced pulmonary tuberculosis is an indication for medical and hygienic treatment, and should absolutely preclude operative measures The medical treatment includes open-air life, and a liberal, easily digested diet Tonics should be administered, iron, arsenic, cod liver oil, and malt

The surgical removal of the appendix is always indicated in the primary cases of the disease, also in cases where the systemic lesions are latent and inactive The arguments against operation are (1) That usually the appendix is not the only tuberculous portion of the intestinal tract, (2) the irritation of the anæsthetic is liable to cause a violent recrudescence of quiescent pulmonary areas Still further the fear of fæcal fistula from poor reparative power deters many men from operating However, with careful technic, fæcal fistula rarely occurs Gas-oxygen anæsthesia reduces the pulmonary irritation to a minimum, and spinal analgesia absolutely removes it Convalescence is established within a week, thus the hygienic treatment is but little disturbed

### CONCLUSIONS

1 Tuberculous appendicitis occurs more frequently than is generally recognized About 0.5 per cent of all appendices removed surgically are tuberculous

2 There are three forms of the disease, miliary, ulcerative, and hyperplastic The lesion may be primary or secondary to tuberculosis elsewhere in the body The primary form is extremely rare.

3 The diagnosis rests upon the demonstration of an afternoon temperature, progressive weight loss, evening sweats and pain and tenderness in the right lower quadrant

4 The prognosis is unfavorable except in the very rare primary forms of the disease It is best in the hyperplastic form

5 The treatment is operative whenever possible Active pulmonary lesions contra-indicate operation There is no medical treatment of the lesion in the appendix itself Hygienic treatment is indicated in active pulmonary conditions associated with tuberculous appendicitis



# OBSTRUCTION OF THE URETER

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As an etiological generality, the type of ureter obstruction we here discuss is mentioned vaguely or clearly in every modern text as a clinical entity it has never received the attention it deserves Commonly it is ignored altogether

Detection of a secondary pyonephrosis or of a giant terminal hydronephrosis requires no particular diagnostic acumen and certainly these conditions when met are diligently enough attacked To the master urinary mechanic, however, something more than this is desirable Prevention of these conditions is worth vastly more than their cure, and this accomplishment is definitely and persistently associated with the recognition and early relief of ureter obstruction Perhaps of even greater importance, from the viewpoint of the patient, is the possibility of obtaining relief from those years of suffering and ineffective intra-abdominal exploratory excursions which intervene between the time the true but hidden pathology begins and the time it reaches such vast proportions as to speak unequivocally for itself It is with this interim that we deal Our object is to emphasize most strongly the significance of chronic ureter obstruction as a thing of itself, to be treated with the respect its symptom-producing powers demand, to be deliberately sought in possible explanation of certain perplexing clinical pictures, and to be promptly remedied by means often quite simple but quite effective

*Effect of Obstruction*—Obstruction of the ureter may result from a variety of causes, congenital and acquired If the obstruction is incomplete a gradual dilatation of the ureter and pelvis occurs with the eventual production of hydronephrosis, inevitable secondary pressure atrophy of the kidney, and probable secondary infection from stasis and lowered resistance If, on the other hand, obstruction is absolute, one of two conditions results

(a) Primary atrophy, intrapelvic urine pressure blocking the renal vessels at the hilum to such an extent as to prevent the influx of sufficient blood to carry on the renal function

(b) Hydronephrosis, intrapelvic pressure producing the same result here, but the capsular anastomosis being so free as to allow a certain amount of blood to still reach the kidney, insufficient to maintain its function but large enough to cause the gradual pouring out of a transudate—not true urine—which slowly distends the pelvis Of these two effects of complete blockage of the ureter the former is much the more common

Congenital strictures may be dismissed from the present consideration They unquestionably occur frequently and the literature has rather thoroughly canvassed them from every point of view To claim as do Bottomley and Eisendrath that they are more common than the acquired forms or that the

latter are in most instances essentially congenital in origin is, we are convinced, a mistake, except that certain types of stenosis, as will be shown later, manifest themselves first, as would be supposed, at the points of anatomic narrowing in the ureter

Of the acquired obstructions, several types may also be eliminated from the discussion. The stenosis resultant upon a tubercular ulceration is well known, but we are here less concerned with the ureter than we are with the excision of the kidney above. Obstruction due to lithiasis concerns only removal of the stone, though the same is not true of obstruction secondary to traumatism from a stone that has been removed or been passed. The ureter may be blocked to a greater or lesser degree by the pressure of tumors from without or within or by involvement in malignant growths, most common of which is carcinoma of the cervix uteri. Infections other than tubercular may be associated with secondary stricture and a variety of other possibilities might be enumerated.

*The Earliest Stage*—In all these conditions, however, the primary consideration lies elsewhere than in the ureter itself. The clinical picture then surrounds a tuberculosis, a stone, a pelvic tumor, a pyonephrosis, or a malignant cervix, and the ureter engages attention only incidentally. It is entirely different with the cases we have in mind. Here we present a patient who obviously has none of these things, but who nevertheless has something which persistently though vaguely upsets his balance. There may be nothing more than a chronic backache or there may be severe attacks of abdominal pain. Bladder disturbance may be absent or conspicuous. Urinalysis may show a few pus- and blood-cells, more commonly it is negative even in cases with considerable vesical excitability. The attacks of pain, which in women are often precipitated by onset of menstruation, may, in the absence of urinary findings, so closely simulate appendix or gall-bladder disease as to lead to an ineffective operation. This is particularly true among the large number of cases which present associated gastrointestinal disturbances.

Renal pain is commonly due to tension upon the capsule or within the pelvis or both. The essential symptomatology of ureter obstruction is interwoven with the question of pelvic tension and its clinical manifestations. Unfortunately there is nothing clear cut about the picture. At a subsequent date we will undertake to present in some detail a series of observations on the evidences of pelvic tension as measured by pain, together with a note concerning associated gastric disturbances. At the present time it is sufficient merely to state our deliberate judgment that renal pain has no characteristic differentiating it from other pain. With pelvic tension may come no pain at all (rarely) or pain of any degree of severity, of any location within the abdomen, and of any or no radiation. It may accurately imitate appendicitis, cholecystitis, gastric ulcer, lumbago, sacro-iliac disease, and several other conditions, it may be a vague and indefinite thing, sapping the nervous system and eventually branding the hapless sufferer as a

neurasthenic In reference to gastro-intestinal disturbance it will be interesting to note how often it is possible to produce nausea and vomiting by increasing intrapelvic tension

It will be seen therefore that off-hand diagnosis is here out of the question. The matter is one of nice differentiation and the condition will commonly be overlooked until it is more systematically included among the diagnostic possibilities. Along with cholecystitis and chronic appendicitis as causes of intra-abdominal disorders and of lumbago and sacro-iliac disease as causes of lumbar pain, we should begin to think also of ureter obstruction. When this is done we shall have made a long step. Generally a critical analysis of the case will then at least suggest the necessity of cystoscopic exclusion of the urinary system and thereupon the picture at once becomes clear.

The bladder appearance generally (in our experience) is entirely normal. The ureteral orifices rarely suggest anything in the early stage (and it is this stage with which we are chiefly concerned). Even a small ureteral catheter may glide up to the pelvis without meeting obstruction, and if a further test is not made with a larger catheter there may be no suspicion of narrowing until a few hours later when the patient has a severe reaction due to occlusion of the ureter at the site of stricture from the trauma of catheterization. This occlusion may even occur at once, as we have often observed, and the catheter which a moment or two before passed easily to the pelvis can no longer be made to traverse the ureter. Furthermore, the patient will not fail to have a characteristic attack within the ensuing few hours. This withdrawal and subsequent reintroduction of the catheter in a suspected ureter may prove a valuable diagnostic point.

If, as has been our experience also on several occasions, one has found it necessary soon afterward (the next day) to catheterize again, he will appreciate the situation still further. The orifices are now puffed up and the ureteral mucosæ so tightly swollen that not even the smallest bougie can be passed.

In a majority of cases, however, the stricture is directly discoverable at the first examination and an unusually severe reaction is not necessary to reveal it. The catheter is suddenly halted. The usual manipulations will quickly determine that the obstruction is not due to a simple bend or valve-like fold. We then realize that in spite of normal urine seen coming in fairly normal spurts from the ureter, we have met a definite obstruction. The passage of a waxed catheter up to the point of obstruction will determine (by absence of scratches) that it is not due to stone. If we can slip by with a small catheter, we measure the pelvis and compare its size with that of its fellow, for we are expecting a dilatation. In addition we apply Kelly's pain identification test by overdistention (using the gravity method always). We regard this test as of the utmost value and up to this time have never yet failed to have the patient, with violence (but correctly, as the issue proved), either declare positively that we were off the track or else had hit the trouble squarely on the head.

If the catheter will not pass, we can still, with prospect of success, attempt measurement and overdistention with the hope that the fluid will pass where the catheter will not. On the same principle we may have pyelograms made and graphically outline the contour of the affected ureter and pelvis.

*Dilatation Not Always Present*—As stated above, we expect dilatation. It does not follow that we always find it, or that it is an essential part of the diagnostic data. On the contrary, we would lay great emphasis upon the fact that *in its early stages stricture may cause definite symptoms* '(from pelvic tension) *without any dilatation whatever or any prevention of a steady downflow of urine*. Later, dilatation, first of the ureter and then of the pelvis, inevitably occurs and progresses. In this connection we furthermore wish to note that dilatation in some cases, as shown in the unusual pyelograms (Figs 5 and 6), may be a very transitory affair. When the obstruction is suddenly accentuated, as in a moving kidney or during an acute congestive swelling around a partial stricture, the pelvis may become considerably distended and within a very brief time thereafter may entirely recover its tone.

The stricture from infection is usually near the bladder, but may be near the kidney or at the point of crossing of the brim of the bony pelvis. Obstruction from other causes to be detailed may also occasionally appear elsewhere. There may be a local point of sensitiveness corresponding to the site of the stricture, and pain, during the attacks, may begin here and radiate upward to the kidney or downward to the bladder or both, as classically illustrated in one of our cases. Furthermore, the approach of the catheter tip to the strictured area may arouse an identifying exclamation from the patient.

Finally, it should be noted that stricture may not only result from infection but may be the cause of it. The lowered resistance incident to urinary stasis often invites bacterial invasion. If attention is directed only to the infection and the obstructive element is overlooked, treatment, however diligent, will fail. In such a case the ureter should be regarded as the drainage tube of a pus pocket which has become partly occluded. Introduction of antiseptics into the pocket (lavage of pelvis) will produce temporary improvement but recurrence will be prompt as long as the occluding element remains. When to lavage is added dilatation of the stricture, opening the ureter widely and insuring free and constant drainage, the patient will usually get well.

*Etiological Factors*—A consideration of the etiology at this time, with some reference to actual observations, will further clarify the situation. It is necessary to recall that we are limiting the discussion to a particular type of obstruction and excluding all others. The etiological factors associated with this particular type are, in our experience, as follows:

1. *Systemic Infection of the Ureteral Wall from Distant Foci, such as Diseased Tonsils, Sinuses, Teeth, or Digestive Tract*—Credit for the recog-

nition of this most important factor should go largely to Hunner who, however, in our judgment, emphasizes it unduly at the expense of other types of equal importance. It is apparently a far cry from the tonsil to the ureter, but under the leadership of Rosenow, whether we follow him all the way or not, we are coming to learn something of the strange selective affinities of bacteria. We have under observation at this time a most interesting case of this sort. Symptomatology consisted of intense backache, weakness, and nervousness, with previous history of tonsillitis and mastoid disease, both requiring operation. Urinalysis was negative. A dense stricture was discovered in the right ureter. Pain identification test was absolute. Pyelography (Fig 1) showed the right pelvis small but twice the size of its fellow (relative dilatation) and somewhat deformed. The stricture, after some difficulty, was widely dilated. It is too early yet to judge the results, particularly as the situation is complicated by a degree of mobility of the right kidney which may or may not be controlled by an abdominal supporter which has just been fitted.

In another almost identical instance we have by the same means succeeded in completely transforming a young woman who had undergone an unsuccessful operation for appendicitis and spent many years in the hands of physicians unable to relieve her of pain. This was one of the most clear-cut cases in our series and yet the pelvis of the affected (right) side presented no dilatation whatsoever (Fig 2).

2 *Anatomic Narrowing*—Three points of anatomic narrowing exist in the ureter. Near the pelvis of the kidney, near the bladder, and at the brim of the bony pelvis. In certain cases, several of which have come under our observation (all in women), there is apparently an accentuation of these anatomic narrowings which, under the influence of acute congestion (menstruation), may produce definite pain and other urinary symptoms. At all events in these cases we have not been able to identify any other etiologic factor and the narrowings have not presented the characteristics of true strictures. The trouble is practically always near the bladder.

3 *Appendicitis*—We refer here not to systemic conduction of infection from appendix to ureter but to direct involvement by contiguity. The proximity of appendix to ureter at the pelvic brim and in retrocæcal positions should be recalled. Recently we have been particularly impressed with this consideration. The patient was a young boy with a gangrenous appendicitis. A McBurney incision was made and the appendix removed. Before this was done, however, the operator had stripped up several inches of the ureter which was thick, cedematous, and so extensively involved in the neighboring inflammation that it was at first mistaken for the adherent appendix. The development of a stricture in such a ureter would not be unexpected. The well-known coincidence of urinary findings with retrocæcal appendicitis teaches the same lesson. In one of our cases of this group the patient underwent a second operation for cholecystitis and adhesions which did not exist, her backache and pain being finally and permanently relieved by dilatation of a stricture in the right ureter.

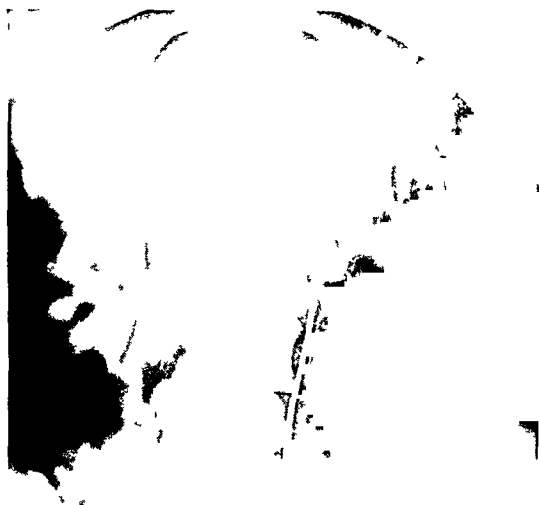


FIG 1—Stricture in right ureter complicated by mobility of kidney. Note relative dilatation (and descent) of right pelvis which by measurement was found to have twice the capacity of its fellow of the opposite side



FIG 2—Stricture in right ureter with marked symptoms *but no dilatation of affected pelvis* either by actual measurement or pyelographic evidence. Complete relief after stretching of ureter

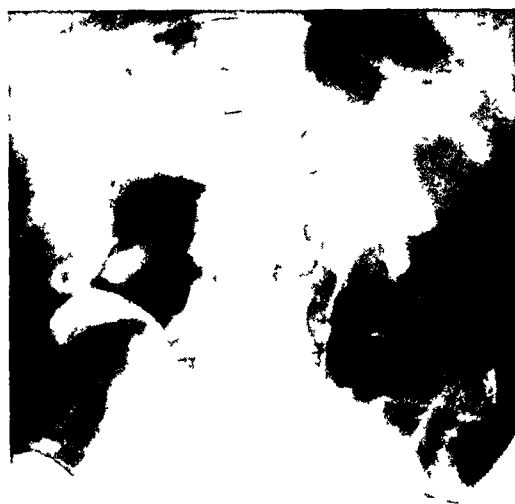


FIG 3—Persistent unilateral pyelitis not relieved until obstruction in right ureter due to mobility of kidney was corrected by high nephropexy. Note torsion of kidney, pelvis occupying a nearly horizontal instead of vertical position

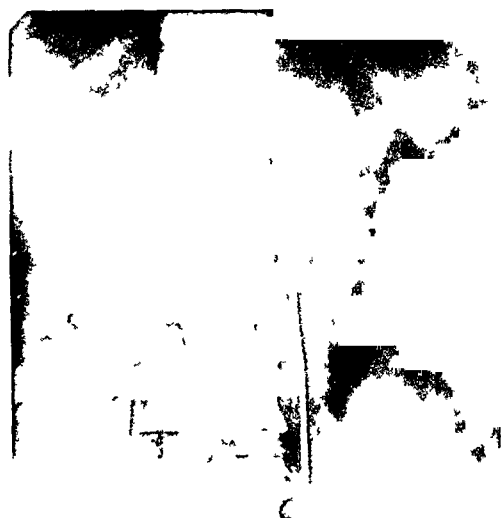


FIG 4—Obstruction of ureter due to prolapse of kidney with which is probably also associated either an aberrant blood-vessel or a constricting fascial band. Note characteristic dilatation of right pelvis, with acute angular ureteropelvic junction



FIG 5 —Extensive hydronephrosis with sharp kinking of right ureter, occurring in patient with infected mobile kidney. Degree of dilatation sufficient to demand nephrectomy



FIG 6 —Same case as Fig 5, taken short time later and exhibiting straight course of ureters and pelves of normal size. The fortunate accident (omission of lead catheters in first plate) which secured this remarkable pair of pictures produces a striking lesson in the ability of an acutely dilated pelvis to recover its tone



FIG 7 —Bilateral hydronephrosis (without infection) due to kinking of both ureters near bladder following total hysterectomy



FIG 8 —Stricture in rudimentary third ureter. Dilatation of this stricture relieved backache for which patient had undergone a number of ineffective operations



FIG 9 —Large hydronephrosis with no other apparent etiology than embarrassment of intravesical portion of ureter by enormously hypertrophied bladder musculature



FIG 10 —Same as Fig 9, showing straight course of ureters which were unobstructed except at bladder wall. After overcoming this obstruction No. 11 Garceau catheters were easily passed to pelvis. Plate taken with catheters of this size in place, each containing a small leaded bougie



FIG 11 —Bilateral dilatation of pelvises due to obstruction of intravesical portion of ureter by hypertrophied bladder musculature





## OBSTRUCTION OF THE URETER

4. *Syphilis*—Undoubtedly Kelly is right in his assertion that syphilis may definitely cause stricture of the ureter and that the affection is probably not nearly so rare as supposed. We have had no experience with this type but expect that a more systematic observation in this direction will in all likelihood be productive.

5. *Mobility of Kidney*—Here we refer simply to obstruction, since this condition does not enter into the etiology of stricture. Its coincidental bearing on the present discussion, however, is so considerable that it is included for purposes of completeness. In one case (Fig 3) persistence of infection of the right renal pelvis, in spite of systematic lavage, suggested stone or stricture, but notwithstanding diligent search no stone or stricture was demonstrable. We succeeded, however, in finding what was tantamount to the same thing—an obstruction due to torsion of the ureter from descensus of the kidney. When this was corrected by high nephropexy the patient recovered. Fig 4 classically shows another case of obstruction and resulting dilatation and infection of the kidney due to descensus, with which is probably also associated either a fascial band or an aberrant blood-vessel, this patient refused operation. Finally, we wish to note again the significance of Figs 5 and 6. Here displacement of the kidney had resulted in such a high grade of hydronephrosis that nephrectomy would have been justified if the second plate had not been made a short time later, showing the complete restoration of the tone of the pelvis after the obstruction had been automatically relieved. Fixation of this kidney would also probably have relieved the right-sided pyelitis which is still present in spite of thorough lavage.

It must not be understood that we are even remotely advocating systematic surgical attacks on mobile kidneys. The ordinary moving kidney is of no significance and the persistent teaching of recent years has thoroughly instilled this into the professional mind. On the whole, this is work well done, but there is danger that the pendulum will swing too far. Indiscriminate contempt for renal mobility is a serious error. In a certain minority of cases the condition is definitely pathological, and, when these cases are carefully sifted out with the cystoscope and the other means at our disposal, operation is not only justified but demanded.

6. *Broad Ligament Inflammation*—The ureter may be directly involved as in appendicitis or it may be secondarily caught and compressed in the dense fibroid mass which sometimes ensues when an acute parametrial infection subsides. This point is also brought out by Clark and Keene in an excellent article on the relation of the urinary system to the female pelvic organs. Frequent observations during our pelvic operations commend this factor to serious consideration.

7. *Stone*—It should be noted in passing that the traumatism produced by a stone which has been expelled or removed may later on itself assume primary importance as a cause of obstruction due either to cicatricial contraction or to infection at a point of lowered resistance.

8. *Operations*—Repair of the pelvic floor following ordinary hysterectomy

tomy may involve the ureter either by displacement and distortion or by definite involvement in scar tissue. We have noted several cases of this type but refer to only two which were quite striking. Six months previously in another city a fibroid tumor of the uterus was removed from one of these patients. Two months after the operation she began for the first time in her life to have urinary disturbance. When she came to us she was nearly bedridden with frequent urination and pain which started near her bladder and radiated upward to her abdomen and back. Urinalysis was negative. Bladder appearance was insignificant. The left ureter was clear. On the right side a tight obstruction was met. As soon as the catheter tip reached this point the patient complained of the characteristic pain near her bladder and the pelvic distention test proved an indisputable further identification. A waxed catheter showed no scratches. Specimens from both kidneys were normal. The capacity of both pelves was small. The stricture was widely dilated and the improvement in the patient was spectacular to a degree. In the other case total hysterectomy had been done a few years previously. The patient now came to the hospital with pain in the right side and an easily palpable tumor extending downward from the right costal margin. The cystoscope disclosed bilateral ureteral kinks a short distance above the bladder, producing definite obstruction with hydronephrosis on both sides, but with absolutely no evidence of infection. Pyelograms showed the pelves as illustrated in Fig 7.

9 *Pregnancy*—Obstruction of the ureter may occur from pressure of the pregnant uterus resulting in temporary low grades of hydronephrosis. The well-known pyelitis of pregnancy is doubtless coincident upon this condition. In addition the lower end of the ureter may suffer from the trauma of labor and the result may be a stricture or an outright necrosis with ureterovaginal fistula.

10 *Renal Infection*—In the opinion of Hunner, stricture is the primary condition when it is associated with infection in the pelvis or kidney. Furniss takes the opposite view and declares that many hæmatogenous infections of the kidney persist as pyelitis, ureteritis or cystitis with consequent contraction and stricture so far as the ureter is concerned. Kelly appears to agree with Furniss and adds, "Although a secondary development the strictures in such cases assume primary importance, for the infection cannot be relieved so long as they exist." Our experience would lead us to agree with both views in the sense that we believe some strictures to be primary and the cause of subsequent infection of the kidney, and some infections of the kidney to be primary and the cause of subsequent stricture of the ureter. This is the "descending type" according to Furniss, and the colon bacillus is the chief offender. There is also an "ascending type" with which the gonococcus may be associated, according to Garceau. Both Furniss and Hunner quote Kelly as authority for the statement that gonorrhœal ureteritis is very rare and yet Kelly in his latest publication declares "Gonorrhœal infection is a common cause, many cases being on record."

11. *Anomalies*—Unilateral reduplication of the ureter is fairly common. The supernumerary ureter and its pelvis are generally rudimentary in size. Either infection or stricture or both are extremely likely to occur here. In one of our cases (Fig 8) the patient had undergone three abdominal operations, the last of which was partial colectomy. The right-sided pain which was one of her outstanding symptoms persisted in spite of all this. We determined the presence of a tight third ureter with a low-grade pyelitis in its pelvis. Dilatation of this ureter and irrigation of the pelvis relieved her and she went more than a year without pain. Subsequently she began to have trouble again and cystoscopic examination showed a definite recurrence of the stricture which required additional dilatation together with enlargement of the orifice with ureteral scissors.

12 *Hypertrophy of Bladder*—Finally, we wish to note an obstructive factor which may be present either with or without the association of what appears to be a type of paresis of the renal pelvis. A very cursory and incomplete inspection of the literature furnished us with no references to bladder hypertrophy as a cause of ureteral obstruction. In several cases, however, we have been highly impressed with the importance of this condition. In one of these the patient was about to undergo operation for cholecystectomy when an inquisitive cystoscopist extracted the supposed hydrops of the gall-bladder through a ureteral catheter. Constant straining to overcome a mild grade of retention due to cystocele had produced in this patient an extensive muscular hypertrophy, the bladder wall being honey-combed with trabeculations which could not be obliterated by water distention. A considerable hydronephrosis was present on the right side (Fig 9) and a lesser degree of dilatation (by measurement) on the left. The ureters were straight and unobstructed (Fig 10) except where gripped by the contracting bladder. Apparently the sole condition here was insufficient expulsive force in the pelvis to overcome the resistance produced by the engagement of the vesical portion of the ureter in the hypertrophied musculature.

It must be explained that we do not refer to the very common and well recognized types of hydronephrosis due to urethral, prostatic, or other obstructions in which the ureteral orifices and ureters become widely dilated so that the bladder becomes practically continuous with the pelvis. The type we here present is an entirely different affair. *The ureteral orifices are not dilated but contracted, an essential point in the consideration.* Responding to the demands made upon it, the bladder musculature has undergone great hypertrophy which has involved the region of the intravesical portion of the ureter as well as the remainder of the bladder. The termination of the ureter then rests among accentuated contractile elements which may seriously embarrass it. We have beautifully illustrated this in a recent case. With the bladder distended to its utmost capacity and the bands flattened out, large catheters (Garceau No 11) can be easily passed to both pelvises. With the bladder less distended, however, and the trabeculations standing out boldly, obstructions can be felt in the intravesical portion of both ureters.

and at this time even small catheters are with much difficulty engaged in the orifices. The effect on the patient is well illustrated in Fig 11

*Treatment of Obstruction*—The clinical picture here presented represents the early "benign" stage, the underlying pathology of which is a ureteral obstruction that is only partial as yet, that does not prevent urine from passing steadily into the bladder, that, however, maintains a certain grade of resistance resulting in intrapelvic tension sufficient to occasion chronic discomfort, that in the presence of acute congestion (as from menstruation, superimposed infection, etc.) may suddenly become much accentuated, precipitating severe colics from transient hydronephrosis, the latter sometimes being accompanied by gastro-intestinal and systemic disturbance. The essential clinical signs, therefore, are chronic pain in the back or elsewhere and attacks of colic with either or both of which may or may not be associated digestive upsets, bladder disturbance, and pathologic elements in the urine. The remainder of the diagnostic data is elicited by the cystoscope, as explained.

It is in this benign stage that diagnosis should be made and treatment instituted. If this is not done the pathology gradually changes and the symptomatology along with it. The obstruction becomes more and more serious and the intrapelvic tension greater and greater. Eventually definite hydronephrosis occurs, the kidney parenchyma suffers from pressure, and the devitalized organ becomes an easy prey for bacterial visitants. When this occurs the opportunity for conservatism has generally passed. The condition may be discovered, however, at any point between these initial and terminal stages. The clinical symptoms and cystoscopic disclosures will then be modified according to the extent to which the condition has progressed up to that time.

The individual case will suggest the proper treatment. If the condition is unilateral and serious involvement of the renal parenchyma has ensued from infection or hydronephrosis, nephrectomy will probably be required. Obstruction dependent upon mobility of the kidney will necessitate fixation and simultaneous division of the fascial bands or aberrant vessels generally responsible for the real trouble, of these two procedures the latter is considerably more important. Plastic operations on the pelvis and upper ureter may be done in other cases. All these measures are the more radical. In the early strictures, before irreparable damage has been done to the kidney—that is to say in the stage which has concerned us chiefly in this review—more conservative remedies are available. The simplest, and in the majority of cases the best and most effective, measure is dilatation of the stricture from a vesical approach by means of bougies, dilating catheters, or metal instruments.

If this is ineffective or inapplicable, the pelvis or ureter may be opened above the stricture and retrograde dilatation done. Finally, if the stricture is particularly dense and the involved segment is of considerable length, the ureter may be divided and the proximal end reimplanted in the bladder.

## OBSTRUCTION OF THE URETER

In our experience thus far, dilatation from the vesical side has been all that was necessary, but we do not fail to bear constantly in mind the propensity of dilated strictures to re-contract. We use the Kelly, the Braasch, or the Buerger type of cystoscope, according to circumstances. Our experience with wax bulbs has not been as satisfactory as Hunner's, since in our hands the bulb often yields before the stricture, this may be more the fault of our wax than of the method. The Garceau type of catheter and the solid dilating bougie with filiform end have been our instruments of choice. The further details of the process are of interest chiefly to the cystoscopist.

### SUMMARY

1 For clinical purposes obstruction of the ureter may be separated into two classes. (a) The ureteral condition is a mere incidental consideration, the dominating pathology lying elsewhere, within or without the urinary tract. (b) The obstruction itself constitutes the essential pathology. In the former, treatment must be directed elsewhere than to the ureter, in the latter, relief of the ureteral obstruction will cure the patient if undertaken early enough.

2 The second type, which is that chiefly concerned in this review, is associated etiologically with a variety of commonplace conditions and is of far greater incidence than even imagined by the ordinary observer. The most frequent etiologic factors determinable are (a) Involvement of the ureter in some distant focal infection, such as tonsillitis, (b) excessive mobility of the kidney associated with fascial bands or aberrant blood-vessels, (c) renal infection with concurrent or subsequent inclusion of the ureter, (d) distortions of the ureter following pelvic operations, (e) local traumatism or infection associated with passing calculi, (f) cicatricial residues surrounding the ureter following appendicitis and broad ligament inflammation, (g) hypertrophy of the bladder. In a certain percentage of cases the etiology will remain questionable or entirely undiscovered.

3 Symptomatology is primarily associated with pelvic tension, a condition producing pain of so variable a character as to promote the utmost diagnostic confusion. Chronic digestive disturbances may or may not be present. The urine is as often negative as not.

4 The conditions most often simulated are chronic appendicitis, cholecystitis, lumbago, sacro-iliac disease, post-operative adhesions, and neurasthenia.

5 In the presence of indefinite symptomatology, ureteral obstruction must hereafter be included among the diagnostic possibilities and must be excluded before we can feel justified in removing a "chronic appendix" or dismissing the patient as a "chronic neurasthenic."

6 The diagnosis is made with the cystoscope and the pyelogram, though it must be constantly borne in mind that symptom-producing obstruction may exist without hydronephrosis.

7 Treatment consists of relief of the obstruction by such means as may be required in the given case.

# ON GASTRIC AND DUODENAL ULCERS FROM A SURGICAL POINT OF VIEW\*

By ABRAHAM TROELL, M D

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## I FREQUENCY, LOCALIZATION, SYMPTOMATOLOGICAL AND DIAGNOSTICAL CONDITIONS

AMONG 234 cases of chronic ulcers operated on in the Seraphim Hospital, in Stockholm, during the period 1907-1914, 76 per cent were localized to the stomach and 24 per cent to the duodenum. Of the former, 36 per cent occurred in men and 74 per cent in women, of the latter, 67 per cent in men and 33 per cent in women. Of all the male cases, 63 per cent had gastric ulcers and 37 per cent duodenal ulcers, of the female ones, 86 per cent and 14 per cent respectively.

More than half of all the ulcers (or of the sequelæ of ulcers) in the stomach were extrapyloric, *i e*, situated proximally to the *canalis egestorius*, while the total number of both gastric and duodenal cases with juxtapyloric localization, *i e*, in or in the vicinity of the pylorus, by almost 10 per cent exceeded the frequency of extrapyloric stomach ulcers.

Multiple ulcers were traced in about 5 per cent of all the cases.

The time when the ulcer pains appeared gave no important, or for the diagnosis definite, distinction between gastric ulcers and duodenal ones, among the cases with late-appearing pain there were a considerable number—about 50 per cent—of gastric ulcers, while among the cases with early-appearing pain were not a few duodenal ulcers. Pains commencing soon after meals seemed to indicate an extrapyloric gastric ulcer, and late-occurring pains gave preponderate reasons for suspecting a juxtapyloric gastric or duodenal ulcer. Those patients who complained of pains appearing tardily after meal, nightly pains, and hunger pains, in far more cases—about 66 per cent—had juxtapyloric (gastric or duodenal) ulcer than extrapyloric gastric ulcer. Even patients with pains occurring soon after meals had, however, to a great extent—in close upon 50 per cent—juxtapyloric ulcer, on one side or other of the pylorus. Those patients with extrapyloric gastric ulcer who had pains later than two hours after taking food, all had residue. The total acidity in extrapyloric gastric ulcer with hunger pains, and in juxtapyloric duodenal ulcer with pains within an hour after food, was, on the whole, relatively high. (Throughout, the figures for the total acidity were obviously low in all patients with ulcer, though higher in duodenal than stomach cases.)

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\* This paper is a very brief abstract of a more extensive one, the contents of which was read in the Swedish Medical Society on April 18, 1916 ("Svenska läkaresällskapets handlingar," XXXII, p 1343-1480)

Hyp- and anacidity occurred both in duodenal and especially in gastric ulcers. As an average, the acidity was lower for cases with residue than for those without, 40 and 53 respectively. Disagreements and variations in the results obtained by different examinations concerning the motility of the stomach were not uncommon. They confirm the known fact that X-ray examination is, as a rule, a more satisfactory method for proving slighter disturbances of gastric motility than either the bilberry or prune test at ordinary test-meal examination. They occur at pylorospasm, but also in a number of cases in a manner which makes one believe that a stomach in which an organic stenosis has begun to give great demands on its motoric power, in spite of the compensatory hypertrophy of its muscular coat, cannot always overcome the obstruction—at a still narrower stenosis it can never overcome it satisfactorily.)

There are—at least for a time—absolutely painless ulcers, all such cases in this material have had a localization to the frontal wall of the organ in question, but both juxtapylorically and extrapylorically.

Of those cases where taking food has caused alleviation of pain, two-thirds have had ulcer of the stomach (no less than 11 of them have had extrapyloric ulcer). For 15 per cent of all cases it is stated that spontaneous or induced vomiting has caused alleviation of pain.

The connection between evacuation of the bowels and pain appears in some cases to be that pains are caused by violent traction upon the adhesions to the posterior peritoneum parietale (proceeding from ulcer adjacent to intestines, especially to colon transversum), a straining which is induced by the accumulation and the aggravated difficulty of passing hard fæces through the large intestine.

Diarrhœa appeared, periodically and alternating with constipation, in some ulcer cases (22 *ulcera ventriculi* and 5 *ulcera duodeni*).

At times it is impossible by palpation of the stomach in the laparotomy wound to absolutely decide whether there is any ulcer or not. Various places in the stomach and duodenum offer various possibilities for the operator to correctly interpret an eventual pathological change. There are good reasons to claim that a palpable small callosity in or quite close to the pyloric ring does not, as a rule, imply an open ulcer, while a similar find—a circumscribed thickening of the wall without palpable crater—in parts more distant from the pylorus often proves in the removed specimen an ulcer that sometimes penetrates to a good depth.

There is good reason for retaining the chemical denomination “ulcer tumor” as the term corresponding to a certain pathologic-anatomical ulcer type, the slowly perforating, adjacent-organs-attacking ulcer.

X-ray examination has been found very important, chiefly as it is able to discover ulcers in the lesser curvature (“niche”). The niche-symptom, in respect to indication, is as valuable as the presence of pyloric obstruction, continuous residue in the stomach, the impossibility of



excluding cancer, and more valuable than pain caused by perigastritis, repeated hæmatemeses or melæna, in spite of due internal treatment. It is, however, necessary to have in mind other possibilities than ulcer when interpreting pouch-like excavations in the gastric wall. The Röntgen plate may show such that are not of niche nature, this, for instance, depending on perigastric adhesions.

It is not in every case, though in very many, that the Röntgen rays can definitely determine whether an anatomical hour-glass stomach be present or not. (The frequency of hour-glass stomachs in the ulcer cases under consideration amounts to fully 10 per cent, the purely clinical symptoms do not, as a rule, deviate in any characteristic manner from those of other chronic ulcers of the stomach.) "Mixed stomach" (*i.e.*, hour-glass form on a partly organic, partly spastic basis) occurs only exceptionally.

Heliciform deformation of the stomach may perhaps, for a part, be caused by the ligation of the gastric artery (without ulcer excision). Röntgenologically in such deformation there has at times been observed a filling defect in the bismuth shadow of the horizontal part of the stomach ("sinus" and "canalis"), a backward bending of the pylorus region, or a considerably increased breadth of the stomach cavity (as in organic pylorus stenosis).

As to the Röntgen diagnosis of duodenal ulcer, it may be stated that such signs as tenderness of the duodenum niche, the presence of occluded gas high up in the duodenum vertex (critically computed), a constant incisura of the duodenal wall, a permanent contraction of the entire bulbus duodeni, a very rapid passage of food through the duodenum (hyperperistalsis, or antiperistalsis), have never proved diagnostically misleading. Less reliable are such symptoms as a localization of the pylorus more to the right, a distention of duodenum, or a longer remaining of food than usual in the duodenum (residue). On the whole, it may be stated that, as regards diagnosing duodenal ulcer, after due consideration of the radiological findings, they form a valuable plus to the characteristics of this disease, faint and difficult to interpret as they oftentimes are.

## II OPERATIONS AND OPERATIVE RESULTS, LATE INVESTIGATIONS (CLINICAL AND RADIOLOGICAL)

A comparison between the operations for ulcer in the Seraphim Hospital before 1907 and after that year proves that palliative operations during the latter period have to a considerable extent been superseded by more radical methods. Thus, previous to 1907 pyloroplasty was carried out in more than 4 per cent of the cases, while after 1907 in scarcely  $\frac{1}{2}$  per cent. The figures for the frequency of gastro-enterostomy were 60 per cent and 44 per cent respectively. The proportion of 6 per cent

and  $\frac{1}{2}$  per cent respectively for entero-anastomosis indicates that anterior gastro-enterostomy has been substituted more and more by posterior gastro-enterostomy. A quite corresponding increase is stated concerning the radical ulcer operations. In the first series excision (segmentary resection with or without gastro-enterostomy) had been made in scarcely 5 per cent of all the cases, in the second series in 10 per cent. Resection (pylorectomy with gastro-enterostomy) had increased from about 5 to 26 per cent.

Primary mortality from operations shows a decline from 8.5 per cent to 6 per cent during these periods for the entire series operated on, from 4.5 per cent to scarcely 2 per cent for the gastro-enterostomies, and from 20 per cent to 8 per cent for the resections (pylorectomies) with gastro-enterostomy, for ulcer excision (segmentary resection) without gastro-enterostomy the mortality is remarkably high (67 per cent and 33 per cent respectively), for ulcer excision (segmentary resection) with gastro-enterostomy very low (0 per cent). The cause of death after ulcer excision (segmentary resection) and after exclusio pylori (Doyen's and Eiselberg's method)—of each three cases—was invariably peritonitis, three of the others died of pulmonary embolism.

The results of the after-investigations (undertaken one to nine years after operation—12 per cent of the patients did not present themselves for these examinations) show that of the entire number of patients still alive 70 per cent have fully recovered or improved, while 12 per cent had to submit to a new operation, and  $3\frac{1}{2}$  per cent had died of gastric diseases. The corresponding figures for the total conservative operations are 66, 14, and 3 per cent respectively, and for all the radical operations 76, 8, and 4.5 per cent respectively. Calculated only with regard to the two usual forms of operations, gastro-enterostomy and resection (pylorectomy) and gastro-enterostomy, the figures obtained are 68, 12, 2 per cent and 83, 5, 2 per cent respectively for those patients who survived any length of time after their operation. Of the total number of patients submitted to gastro-enterostomy, 66 per cent recovered or improved, while those with resection (pylorectomy) and gastro-enterostomy performed recovered or improved in 77 per cent. Poor remote results, *i. e.*, the recurrence of symptoms subsequent to an ulcer operation in many cases certainly depends to a considerable degree on the surgeon's neglecting, after each operation for ulcer, to give dietetic and other prescriptions suitable for ulcer.

If the remote results be considered by taking the localization and nature of the special changes as a starting-point, a very good result may be proved (*i. e.*, recovery or improvement) as following resection (pylorectomy) and gastro-enterostomy and simple gastro-enterostomy for *ulcus ventriculus extrapyloricum* in 83 per cent, respectively 76 per cent of the surviving patients; primary mortality 0 per cent, respiration 0 per cent. *Ulcus ventriculus juxtapyloricum* in 88.5 per cent, respiration

81 per cent of the surviving patients, primary mortality 10 per cent, respiration 6 per cent Pyloric obstruction in 83 per cent, respiration 65 per cent of the surviving patients, primary mortality 8 per cent, respiration 0 per cent Ulcus duodeni in 90.5 per cent, respiration 55.5 per cent of the surviving patients, primary mortality 8 per cent, respiration 0 per cent All cases operated on, 87 per cent, respiration 68 per cent of the surviving patients, primary mortality 6.5 per cent, respiration 2 per cent

The superiority of resection (pylorectomy) + gastro-enterostomy to simple gastro-enterostomy is consequently manifest for all localizations of ulcerous changes, satisfactory remote results having been obtained for more than four-fifths of the resection cases surviving, but, as a rule, for scarcely three-fourths of those with only gastro-enterostomy performed, this without any far too important increase in the immediate risks of the operation engendered by radical measures Necessary subsequent operations have occurred far oftener after gastro-enterostomy than after radical operations, proportionally about 2 to 1 Death in cancer has ensued in 2 to 3 per cent of all the ulcer cases With our present knowledge, it is impossible to state, even approximately, how often a gastric ulcer may undergo malignant degeneration Concerning the question of resection or gastro-enterostomy to be claimed as the normal method for ulcer, the problem of *ulcus carcinomatosum* cannot as yet be of any great importance, except in so far as the knowledge that it is, in operations, impossible by eye and hand to absolutely determine, in any case, between cancer and ulcer, may be an incentive—in otherwise favorable circumstances—to remove every extirpable ulcer or sequela of ulcer seen in these laparotomies, the gross pathological picture *in vivo* oftentimes being very misleading, according to experience gained In laparotomies on account of ulcer the surgeon should strive to decide at as early a stage as possible, whether extirpation (*i.e.*, resection, excision) should be undertaken or not, should it not be done, the lysis of adhesions, especially in suspected regions, must be undertaken with a certain degree of caution, and with due care that penetrating ulcers (whence perforation as a speedy consequence of the operation may threaten) may be passed over to a minimal degree

Among other abdominal complications following on operations, *circulus vitiosus* and *ulcus pepticum jejunum* are most specially to be taken into consideration Also, from the ulcer series at hand, it appears that concerning the development of *circulus vitiosus*, among other causes too great a length of afferent duodenal loop in posterior gastro-enterostomy plays a certain rôle

For diagnosing an *ulcus pepticum jejunum*, X-ray examination may be a good help (bismuth-shadow of the pouch that may be formed by the ulcer penetrating towards colon, see Fig 1) On the occurrence of *ulcus pepticum jejunum* the use of uninterrupted silk as suture of the

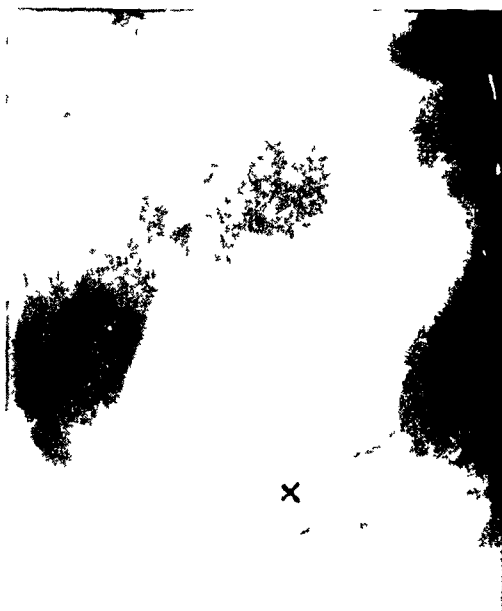


FIG 1 —Resection (pylorectomy) and gastro-enterostomy (Billroth method, No 2) performed in July, 1911. Excellent condition for the next three years, then symptoms of ulcer pepticum gastrojejunalis. X-ray examination in February, 1916, which showed, among other things, residue in the stomach and immediately below that shadow a bismuth-filling (X) of the size of a big walnut, which, according to the operative findings, corresponded exactly to a big pouch formed by a gastrojejunal peptic ulcer penetrating toward the colon. This ulcer was resected, an atypical anastomosis was done, and the patient recovered.

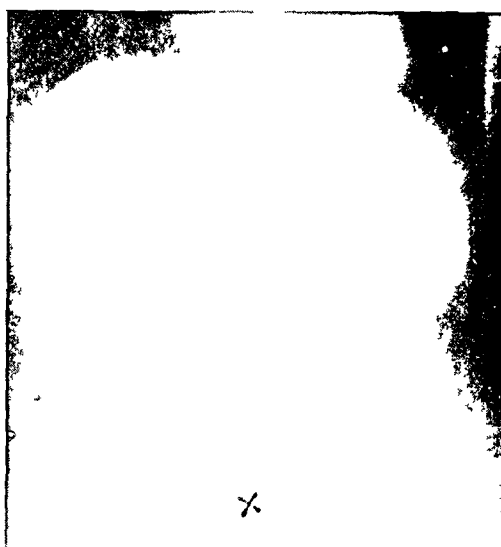


FIG 2 —Resection (pylorectomy) and gastro-enterostomy (Billroth method, No 2) performed in October, 1912. Only slight improvement, after three years a number of symptoms persisting. X-ray examination in January, 1916, showed, among other things, a four-hour residue in the stomach between the gastro-enterostomy opening and the pylorus (X).



deeper layers of the gastric wall may be of significance. Among the more unusual postoperative local complications there may be taken under consideration not only the incarceration of small intestines in bursa omentalis (to avoid which it is of importance to regularly sew the margins of the mesocolon opening to stomach or intestines, round the place of the gastro-enterostomy), but also there is to mention the chronic, more or less complete, volvulus of the stomach, eventually caused by the strings and adhesions, and not necessarily accompanied by symptoms of ileus.

The X-ray examination gives valuable information for the interpretation of the postoperative stomach physiology, 64 patients of the ulcer series in question have been submitted to it. As to that point the results of experiments on animals cannot be transferred to clinical conditions without further ado. X-ray examination made some lengthy time after gastro-enterostomy on ulcer patients proves that the food passes exclusively through the anastomosis, not only in pyloric obstruction, but also in most of the cases with permeable pylorus. Quite exceptionally the pylorus takes some part, or to a greater extent than the anastomosis, in allowing the food to pass, or even the entire contents of the stomach go through the pylorus. To what degree the localization of the new opening plays any rôle for the deliverance of the gastric contents means little, on the whole, so long as it is only a question of such slight obstruction of motility as a bismuth residue after four hours, which, in itself, is of no importance as regards clinical symptoms. Location of the gastro-enterostomy toward the pylorus appears, however, to offer the best guarantee for a satisfactory function thereof, even if the position of the new opening does not mean the only factor for determining the way of passage for the gastric contents. With regard to the relation between the functional power of the gastro-enterostomy and the ulcer troubles of the patients, the experience in the Seraphim Hospital proves that the group with food passage only through the anastomosis for the most part consists of completely, or almost completely, restored cases (when this does not happen, a special reason is, as a rule, discernible). In those patients where the pylorus, in spite of the gastro-enterostomy, continues, more or less, to deliver gastric contents there remain slighter or more severe clinical troubles, not seldom of neurotic kind. X-ray examination after resection (pylorectomy) and gastro-enterostomy proves on the one side that "paradoxal residue" is not so very rare, and on the other one that a small residue even at a lengthy period after the operation may occur without itself being of any clinical importance. With regard to the possibility of pouch formation in the stomach distally to the spot where gastro-enterostomy was performed (see Fig 2), it is desirable to make the gastro-enterostomy as far to the right as possible (near the place of resection). The risk of pouch formation—the clinical rôle of which cannot be denied—is also present in exclusio

pylori by circular constriction through an aponeurotic strip, a silk thread, etc., and vindicates the demand that, when this operation can be considered worth trying, the gastro-enterostomy should be established near the pylorus. The uncertainty in the results of these conservative exclusion methods compared to the experiences above, gained from simple gastro-enterostomy in cases of open pylorus, makes it very doubtful whether there are any valid reasons for their further employment. Rissler's method, perhaps, with slighter risk, gives equally effective results as operation, according to Doyen and Eiselberg. Subsequent to resection in continuity + suture end to end, there is a certain risk of secondary hour-glass formation. For radical hour-glass operations the same rules hold good principally as regards corresponding operations for other ulcer conditions, as also (where suitable deformation and motility circumstances are present) in gastro-enterostomy. Among the more complicated conservative operations gastro-enterostomy + gastro-enterostomy of the pyloric pouch has given good motoric and functional results, while lateral anastomosis between the cardiac pocket and duodenum, on the contrary, has given bad results (pouch formation).

Relaparotomy undertaken several years after gastro-enterostomy proves that the gastro-enterostomy, as a rule, has no tendency of gradual closure—not even if the pylorus at the first operation were open—unless special conditions were present (anastomosis by Murphy's button, complicating peptic gastrojejunal ulcer (?), subsequent cancer, etc.). A gastro-enterostomy may, in the course of years, cause the dissipation of a scarred pyloric obstruction. It may also, already in the course of a couple of months, induce a diminution of the volume of a dilated stomach.

The majority of the ulcer cases operated on, on subsequent examination appear to have normal total acidity, and that even when clinical troubles still persist, the degree of acidity scarcely is of decided importance for the non-appearance of improvement after an operation.

Constipation in ulcer patients is usually promptly and definitely obviated by an otherwise effective ulcer operation. This is generally also the case as regards diarrhœa occurring in ulcer. Postoperative diarrhœa seems to stand in some connection with such pancreatic changes as are characterized by the destruction of the parenchyma. They are not, as far as can be proved, attributable to a too broad gastro-enterostomy, or to a too rapid deliverance of the gastric contents to the intestine (both these conditions have been observed without diarrhœa occurring, as also the contrary conditions have been seen in operated cases with diarrhœa). Neurotic moments are probably more responsible for the appearance of diarrhœa.

There is much that speaks for constitutional, neurogenous, and spastic moments being of very considerable significance for the structure of the due understanding of ulcer disease. For instance, the fact that some-

times shows cases clinically diagnosed as ulcer, but in laparotomy without undisputable anatomical ulcer changes (scars, craters, etc ) Among these cases there are 40 per cent with no improvement, or worse, after operation, while the corresponding figure for all other operated ulcer cases (*i e*, with absolutely obvious chronic ulcer changes) shows just 10 per cent, this fact thus urging the surgeon in such negative cases to refrain from any operation on the organ in question These negative cases with bad operative results are to a considerable extent neurotic individuals Moreover, in the remainder of the ulcer patients, too, on closer scrutiny, signs will be found that point to an etiological significance for ulcer of constitutional, neurogenous, and spastic moments general neurotic symptoms, signs of Graves's disease, psychoses, epileptoid attacks, tabes dorsalis, etc (not to mention the signification of the so often seen spastic hour-glass stomach, pylorospasm, gastrospasm, etc, or the results of experimental clinical and purely experimental research concerning vagotonus and sympatheticotonus)



# ANNULAR SEGMENTAL GASTRECTOMY\*

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IN selected cases, the removal of a segment from the stomach appears to leave the organ with as efficient motor power as can be secured by any other resection of a corresponding amount of stomach tissue. In a previous communication, it appeared the stomach's emptying capacity following segmental gastrectomy was not equal to that of a normal stomach but greater than that of a stomach with a saddle-shaped piece removed from the lesser curvature. No explanation was offered for the stomach's respective behaviors after these resections. The following opinion was expressed "This difference in the emptying times may be due in part to the mechanical relations incidental to the gastrectomies themselves but more probably due in greater part to the fundamental disturbances in the neuromuscular motor mechanisms of the stomach." This has been taken as a working hypothesis for further experimental and clinical study which forms the basis of this paper.

I *The Neuromuscular Motor Mechanism* — The intrinsic nervous connections of the stomach are complicated and defy identification. It is fully realized that the vagi, themselves, are not pure cerebrospinal nerves but systems of central and sympathetic fibres to which are added other communications before and after their passage into the walls of the stomach. Other nerve groupings, styled the sympathetic nerves, obviously may not be purely autonomic for a similar reason but, on the other hand, may contain vagus elements. The constancy of any fixed proportion of central or of autonomic fibres in either extraneous nerve grouping is not and, so far as is known, cannot be determined, hence the futility of predicating gastric symptoms and signs to the impairment of either vagus or sympathetic nerve. In the accompanying drawing, the branches of the anterior vagus and the blood supply are represented in detail, if to the nerves indicated are added the great meshwork of sympathetic fibres that everywhere imbed the several vascular branches, some idea of the complexity of the nervous connections is obtained.

It is not surprising that the terms "vagotonia" and "sympatheticotonia" when applied to gastric symptom-complexes are unproductive as working diagnoses. It is similarly hazardous to ascribe very much significance to experiments based entirely upon divisions of these nerves.

Most of the reported experiments are the direct observations of the experimenters or are the inferences drawn from the observed phenomena. Braun and Seidel<sup>1</sup> cut the spinal cord and noted the incapacity of the stomach to

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\* Read before Ex-interne Soc, M E Hosp, April 26, 1917

<sup>1</sup> Braun and Seidel *Mittheila d Grenzgeb, d Med u Chir*, Bd 17, S 533

expel gas, they severed the vagi and found the emptying power to be present or absent and emetics to be powerless. Friedenthal<sup>2</sup> recorded no diminution in assimilation, digestion, and other functions after division of both vagi and splanchnics. Langley<sup>3</sup> held that the intrinsic stomach apparatus reduced by one-half the stomach volume by forcible contractions. Magnus and others reported movements of circular and longitudinal muscle when left in contact with Auerbach's plexus. Unger<sup>4</sup> found acute dilatation followed the division of the vagi in the chest. Others have corroborated these workers or have applied themselves independently in correlated studies.

The technic has been modified since the last series of experiments were reported (AN OF SURG, Nov, 1916, vol lxiv, p 527). There are so many advantages in an open laparotomy over the visualized stomach or in the intra-gastric bag method that it has been used almost exclusively in the following study of the gastric motility, reserving the latter two resources as controls on the former or for the purposes of securing permanent graphic records. The activity phases outlined in the earlier paper have been taken advantage of by feeding each subject preliminary to celiotomy a comfortable amount of diluted meat extract. The effects of ether, morphia, and trauma have been studied especially in relation to the element of time which enters into all experiments and as far as possible have been controlled. Each experiment is carefully written up and preserved. For convenience, the respective numbers, only, will be mentioned hereafter. (The numbers apply to experimental animals represented in the accompanying chart, entitled, "Résumé of Experiments Upon the Dynamics of the Stomach")

Vagotomy was performed in five animals (123, 126, 134, 144, 171). *Thoracic section of the vagi* in these animals was associated with *a more rapid, more superficial fundic wave and an independent forcible pro- and anastaltic pyloric wave*. From this observation, it might be inferred, subject to further experimental proof, that the vagi carry motor fibres to the fundus and the inhibitory motor fibres to the pyloric portion. (This finding<sup>5</sup> is not new but corroborative of those experimenters who have held similar functions for the gastric fibres of the vagus.) Attempts have been made to associate motor changes with the corresponding divisions of extraneous sympathetic nerves but without apparent success.

The intrinsic apparatus is intimately bound up with the blood and vessel system. It is obviously impossible to clamp, ligate, or divide any of these nerve fibres without at the same time equally interfering with the vessels, muscle, and supporting fascia of the stomach or without, in other words, performing stomach block experiments. Of this character are the following experiments. Incisions were carried astride of the lesser curvatures of the stomachs (in the pyloric regions of most animals or in the adjoining fundic

<sup>2</sup> Friedenthal Arch f Anat u Physiol, 1904, S 579

<sup>3</sup> Langley Proc Physiol Soc Lond, 1911, xiii, xxiv

<sup>4</sup> Unger Vide Friedmann, Arch f Verdauungskrank Erganz, Bd 17

<sup>5</sup> See Howell, W H Text-book Physiology, p 665, 1907

portions of many others and, in one, in the vicinity of the cardia) half the perpendicular distances to the greater curvatures on both surfaces of the stomachs down upon or through the mucosa or saddle-shaped sections were removed, similarly, incisions were made completely about the gastric tube or annular segments were resected

Under the conditions of incomplete blocking in seven animals (100, 101, 144, 149, 161, 165, 173) and making allowances for slight variation, it appears that "*triangular*" gastrectomy was followed by more rapid, more superficial, fundic waves and more superficial, incomplete pyloric waves. During the preliminary clamping and ligation there were stronger and slower waves (see Experiments). The peristaltic contractions started high up on the lesser curvature close to (probably actually at) the cardia, traversed the stomach body, and disappeared in the proximal portions of the pyloric end of the stomach. The tonus of the fundus of the "triangularly" resected stomach appeared on the whole equal to or less than that of the unimpaired gastric fundus, the tonus of the pyloric portion, definitely less than that of the normal pyloric end.

In eleven animals (134, 100, 101, 101 six weeks later, 96, 96 six weeks later, 149, 165, 161, 144, 173) after making due allowance for slight variation, it appears that "*segmental*" gastrectomy was followed by normal or stronger fundic waves and independent forcible pro- and anastaltic pyloric waves. For the first few minutes to one hour following necessary manipulation, the waves in the fundic part were superficial. The tonus of the fundic part appeared equal to or greater than that of the normal stomach, that of the pyloric part, markedly greater.

When triangular resection or partial blocking of the caudad stomach is compared with segmental resection or complete blocking it will be seen that the latter method is associated with the more normally balanced fundus and the more actively efficient pyloric part. Furthermore when the effects of thoracic vagotomy upon the pyloric portion are compared with those of segmental blocking, similarity again is found, in other words, the division of the two vagi in the thorax has the same influence upon the motility of the pyloric end of the stomach as severance of the neuromusculature at the pylorofundic junction. These observations agree with the inference offered above after vagotomy, namely, that the vagi carry inhibitory motor fibres to the pyloric portion of the stomach. It appears, therefore, that triangular gastrectomy allows some of these fibres to hold the intrinsic motor apparatus of the pyloric part in check but that segmental gastrectomy removes these inhibiting fibres. In respect to the fundic portions, it will be noted that the body of the stomach is reduced in tone and force of contraction after incomplete blocking and after thoracic vagus section but left with tone and contractions more resembling the normal experimental fundus after complete blocking. It is possible that the centripetal fibres play an important rôle in these latter relationships but, other than this suggestion, no explanation is attempted.

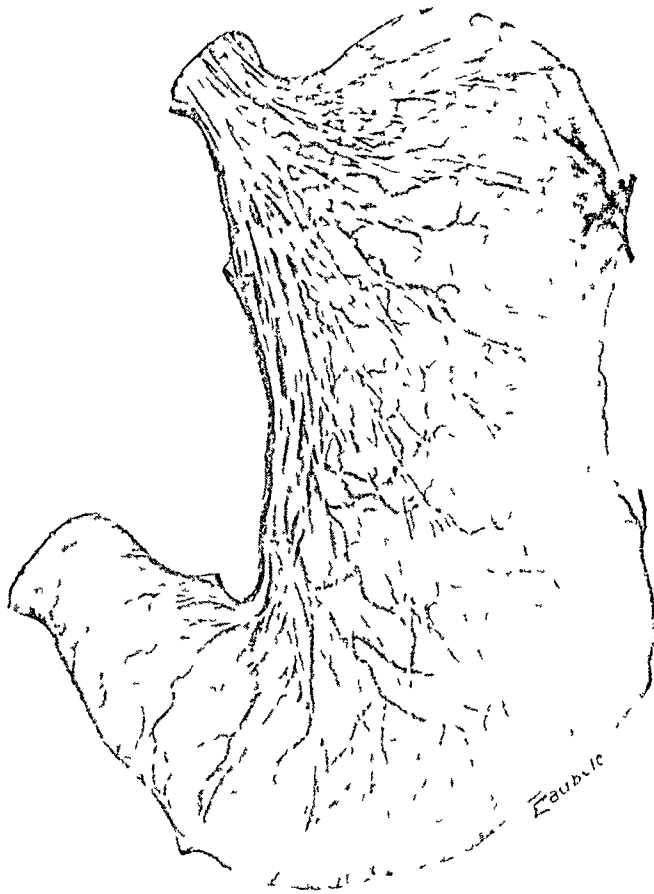


FIG 1 —Drawing of human stomach from cast and from dissected specimen lent by Senior. Note blood supply and extensive ramifications of anterior vagus. Note, also, normal vertical position of organ.

FIG 2

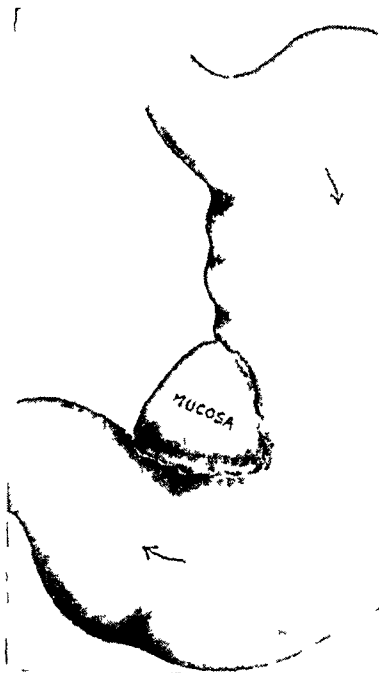
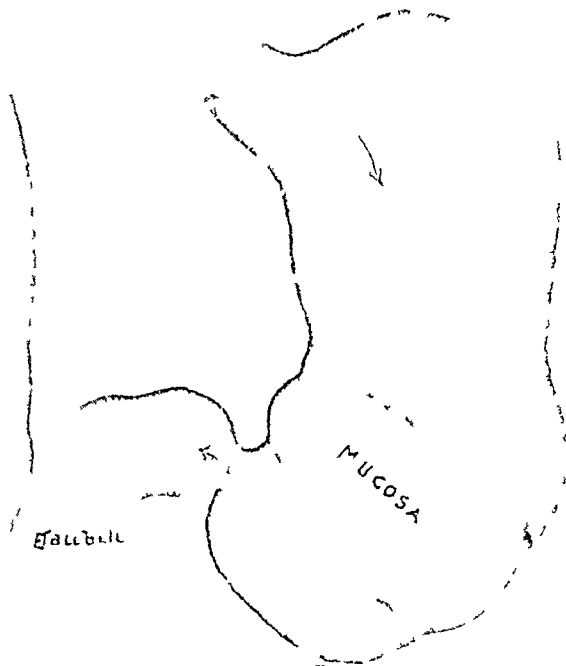


FIG 3



- [ FIG 2 —Experimental triangular gastrectomy indicating superficial peristaltic contractions of fundus and relatively amotile and atonic pyloric part  
 FIG 3 —Experimental annular segmental gastrectomy indicating a one-cycle, fairly tonic fundus and an independently motile and hypertonic pyloric part



FIG 4 — Persistent three cycle type motility four weeks after operation Compare with Fig 3

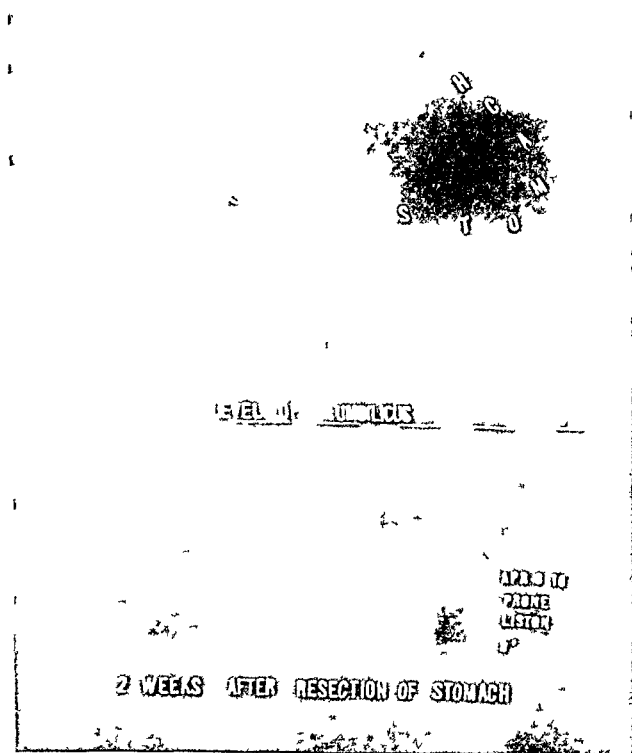


FIG 5 — The more characteristic picture after annular segmental gastrectomy. Note pyloric part not demarcated. The exposure evidently coincides with a phase of pyloric hypermotility commonly observed experimentally.

## ANNULAR SEGMENTAL GASTRECTOMY

These experimental data correspond with experience in human segmental resection for gastric ulcer. A parallelism exists in comparative fluoroscopic studies, also, in human or in canine roentgenograms, and in observations upon resected brute animals (Cf X-rays of human cases with Fig 3). The fundi often require six hours for emptying, many stomach bodies have normal tone and good motility. The pyloric segments often do not appear upon the X-ray prints; this accords with the hypermotility or with the tetany of the distal portions observed in some of the experimental resections.

CASE I—Mr J. S. V. referred to by Dr. J. Nolan, Aug 17, 1916. 36 years. Portuguese. Business man. Always constipated. Epigastric pain increasing in severity during past four years. Loss in weight. Rigidity and tenderness over upper right rectus. Le Wald reported probability of gastric ulcer. August 30, 1916, annular segmental gastrectomy for ulcer at lesser curvature in pyloric region. Pathological report: "Gastric ulcer highly suspicious of early malignant change." Four weeks postoperative residue less than half, condition very satisfactory. At present time reports himself back in business and entirely free from all gastric symptoms.

CASE II—Miss M. McG., case of Dr. J. M. Lynch. Trained nurse. 28 years. U.S.A. Diarrhoea since July, 1916. Epigastric pain 5-6 hours after eating—began 10 years ago. Loss in weight. X-ray showed "almost complete obstruction of the stomach." November 17, annular segmental gastrectomy for gastric ulcer. Pathological report: "Gastric ulcer." Six weeks postoperative the six hour residue was considerably less than the nine hour residue before operation. She reports herself well and comfortably working at her occupation.

CASE III.—Mr H. S. referred by Dr. Matusoff, April 25, 1917. 32 years. Russian tailor. Constipation past 5 years. Epigastric pain, worst after eating, past two years. Loss in weight. Stomach dilated. Hobbs (May 7) reports "almost complete pyloric stenosis with resulting dilatation." May 9, 1917, pylorotomy. Pathological report: "Pyloric ulcer with no recognizable evidence of malignancy." No unfavorable postoperative gastric symptom.

A locus of initial pyloric motility has been observed particularly in those stomachs showing independent pyloric rhythm. This site includes the gastric segment making up the incisura angularis. Its most motile point appears to lie at the junction of the first large branch of the right gastric artery with the lesser curvature of the stomach. Further research is necessary to establish possible nodal significance for this centre. (For convenience this "centre" is hereafter spoken of as the "C-point".)

2 *The Mechanical Relations*—According to the methods above described, the loss of tissue and the resulting scar are greater after segmental than they are after triangular gastrectomy. Whatever applies to obstruction due to the presence of or to the contraction of the cicatrix should pertain more forcibly to the former method. From experience in pyloric occlusion, it appears that persistent total obstruction of the physiologic outlet of the

stomach is a difficult process even when it is purposely attempted. However, were it possible, notwithstanding one's exertions to the contrary, to seriously obstruct the stomach in performing one of these gastrectomies, it obviously must depend upon the resulting scar tissue.

Stricture is said to follow entero-enterostomy of nonperitoneal covered intestine. In experiments completed by the author it appears that all such productive inflammation after intestinal wounds has a rather more definite relation to the vascular supply of the apposed edges. This idea evidently prompted the "elbow" operation and other similar contrivances. The following experiment suggests this correlation of impaired blood supply and redundant gastric scar.

Dog No 168 after morphine-ether and the usual preparation—Stomach divided in two transverse planes and closed by sutures, one, the aboral incision by a Connell suture, being careful to draw in the separate bites so as to *oppose* the cut edges, the other, the oral, a Shoemaker stitch with two needles and oppositely drawn suture material *tautly pulled in to the point of strangulation of the edges* of the stomach wound. Two weeks later, this latter wound although it involved the thinnest portion of the stomach sac was much more indurated and on cut section showed much more and firmer fibrous tissue.

Whatever be the cause of harmful scar tissue after gastrectomy, it ought to apply more to the stomach with the greater wound—segmental gastrectomy.

The mechanical removal of tissue from one curvature and not from the other, as in the triangular method, may result in a deformed stomach but it does not explain the deficiency of tone and the absence of contractile wave in those stomachs, above represented, in which the mucosa was left intact and the original dimensions of the stomachs preserved.

*Résumé*—The removal of an annular segment from the stomach leaves the stomach with greater emptying power than the removal of a saddle-shaped section from the lesser curvature. This relationship is probably dependent upon the discontinuance in the neuromusculature and not upon the mechanical results of the respective operative procedures.

The writer wishes to thank Professor H. D. Senior of the Department of Anatomy, New York University and Bellevue Medical College, for his generous cooperation in the surgical anatomy. He is also indebted to Mr. A. Diem, the Laboratory technician, for his assistance with the experimental animals.

#### RESUME OF EXPERIMENTS UPON THE DYNAMICS OF THE STOMACH

No 311 Gastric wave begins at cardiac end of lesser curvature

No 206 Double clamping lesser and greater curvatures at corresponding points gives strong pyloric contractions, rate 13 cm per sec, recurrence, q 21 sec

No 274 Cat's stomach of 2-3 cycle variety, recurrence of waves q 20 sec. Clamping half across from the lesser curvature gives more forcible pyloric waves, clamping all across gives blocking of pyloric waves

No 24 Dog's stomach of 2-3 cycle variety. Relation of motility to ether;

## ANNULAR SEGMENTAL GASTRECTOMY

waves decrease in height, force and rate but increase in regularity as ether coma approaches, waves increase in height, force, and rate becoming tetanic as the ether is withdrawn Relation to "C-point" Clamping of C-point gives waves more rapid and increase in tone of fundus

No 25 Triangular gastrectomy gives weak waves in pylorus which become through waves from cardia

No 96 Segmental gastrectomy (Iwk p o), Waves of 1 cm per sec in fundus, independent same time rhythm, pro- and anastaltic in pyloric part

No 100 Under morphine-ether waves normal recurrence time is q 25-21 sec After triangular gastrectomy recurrence time is 14 sec After segmental gastrectomy independent rhythm of pyloric part

No 101 Under morphine-ether waves normal recurrence time is q 25 sec and rate 14 cm per sec After triangular gastrectomy recurrence is 14.75 sec becoming more rapid, frequent, and superficial After segmental gastrectomy (whether incision closed or not) tonic fundic part, atonic pyloric part with independent rhythm and waves infrequent, forcible, pro- and anastaltic

No 111 Vagi? Three branches anterior vagus below diaphragm clamped gives waves slower and more superficial (trauma necessarily considerable)

No 117 Vagi? Anterior and posterior vagus above diaphragm cut gives waves of moderate force in pyloric part CO<sub>2</sub>? CO<sub>2</sub>-blood gives increase in tone, localized contraction, total disappearance of contractions, general relaxation

No 123 Vagi? Both vagi cut above diaphragm gives waves forcible in pyloric part, relative amotility in fundic part or waves superficial, frequent, and difficult to follow C-point, clamped, gives waves less forcible and more frequent in pyloric part

No 126 Vagi? Vagi cut above diaphragm gives increase in tone of whole stomach, increase in frequency of fundic waves, increase in force to all waves, does not alter rhythmicity of pyloric waves which are occasionally anastaltic

No 128 C-point, ligated, gives weak fundic waves disappearing at C-point, and traceable with difficulty beyond in pyloric part, decrease in tone

No 134 C-point, clamped, gives waves more forcible in fundus Vagus ends divided at level of C-point gives in fundus waves rapid and superficial, in pyloric part, waves more forcible approaching tetany and independent rhythm Vagi? Vagi above diaphragm cut gives waves weak in fundus

No 144 Triangular gastrectomy gives waves deep in fundus, superficial in pyloric part Segmental gastrectomy gives waves of independent rhythm with pro- and anastalsis in pyloric part (whether wound in stomach closed or gaping) Splanchnics in chest cut gives waves no change Vagi in chest cut gives waves shallow in fundus, no further change in pyloric part

No 149 Waves normally recur at 18 sec intervals Clamping of C-point gives waves of fundus more forcible but slower, waves of pyloric part more forcible and anastaltic All waves decrease in tone 5 min later Suture? Pyloric waves forcible, anastaltic to suture, fundus waves forcible Triangular gastrectomy gives fundic waves superficial to 1 cm of incision, tone plus Segmental gastrectomy gives fundus waves as after triangular gastrectomy, recurrence time 15 sec, tonus same Pyloric waves superficial pro- and anastaltic, localized about distal cut edge, tonus same, recurrence q 18 sec Anastomosis does not alter these waves Cutting of vagi in chest 95 min after laparotomy gives no additional change

No 96 Segmental gastrectomy six weeks postoperative shows tonus of fundus normal, waves superficial and infrequent, tonus of pyloric part normal, waves forcible and tetanic No mechanical obstruction

No 101 Segmental gastrectomy six weeks later gives tonus of fundus sub-normal, motile pyloric part No mechanical obstruction



No 161 Normal stomach gives "through" waves, two at a time, weak, at 22 sec intervals, and continuous. Triangular gastrectomy gives waves same or stronger, at 20 sec intervals in fundic part and after the first 2 to 5 min weak and gradually disappearing in the pyloric part. Segmental gastrectomy gives waves more superficial in fundic part and absent in the atonic pyloric part.

No 165 Normal stomach gives waves q 15 sec occasionally retroperistaltic, moderately forcible, continuous 2 cycle. Suture at C-point gives localized retroperistalsis beginning 1 cm to right on lesser curvature and extending to the suture. Incomplete division of the stomach perpendicularly toward the greater curvature from C-point gives retroperistalsis from pylorus to cardia, waves q 17 sec,  $\frac{1}{2}$  hr later normal prostatic waves disappearing in the pyloric part. Complete division gives waves at first weak in fundus and pyloric part, 53 min later waves forcible in both parts, q 20 sec in fundus and q 40-60 sec, retro- and prostatic in pyloric part.

No 171 Waves (normal) in fundus strong and prostatic, in pyloric part occasional retrostatic waves intercepting strong prostatic wave. Vag1 divided in chest gives waves in fundus superficial and traceable into pyloric part, later to C-point, only, in pyloric part waves generally retrostatic to fundic waves, later strong to C-point only (with an occasional prostatic wave). Sutures placed at C-points serve only to enforce the above as does complete division of the stomach between these points.

No 172 Triangular gastrectomy gives fundic waves superficial, strong in vicinity of incision, three at a time appearing on the lesser curvature, pyloric waves which are the prostatic fundic waves disappearing early in the pyloric part, good pyloric tonus. Segmental gastrectomy gives fundic waves 1-2 at a time, weak or occasionally strong, pyloric waves independent pro- and anastaltic to within 1 cm of incision.

No 173 Triangular gastrectomy gives a moderately forcible 2-3 cycle fundus and a relatively atonic pyloric part with no waves barring the disappearing fundic waves in its proximal portion. Segmental gastrectomy gives a moderately forcible 1-2 cycle fundus with a moderately forcible pro- and anastaltic pyloric part. Site of gastrectomy as near to the cardia as possible.

"C-point" refers to site of special pyloric motility alluded to above.

By the "pyloric part" is meant that part of the stomach distal to the antral sphincter or incisura, the "fundic part," that proximal.

Note that the pyloric part behaves very much as a functional entity. It may be reasonable to speak of the surgical and of the anatomical pylorus, meaning by the former the whole pyloric portion invested by the thicker bundles of circular muscle fibres and of the anatomical pylorus as that commonly understood, namely, the termination of the pyloric end of the stomach canal indefinitely defined as from one-half to one inch in extent.

# STRICTURE OF THE GALL-BLADDER

DUMB-BELL GALL-BLADDER

By W. FRANK FOWLER, M.D.

OF ROCHESTER, N. Y.

THE writer apologizes, as his predecessors have done when reporting a case of so-called hour-glass gall-bladder, by stating that in this particular instance there are unique features of unusual interest. As regards the actual frequency of this type of deformity Dr W. C. MacCarty<sup>1</sup> states, in a personal communication to the writer, that it was encountered at the Mayo Clinic 31 times in a series of 3692 gall-bladders.

We are indebted to Else<sup>2</sup> for an excellent description of gall-bladder strictures based upon his post-mortem investigation of 1100 gall-bladders. Else reminds us that this subject has not received the study and consideration which it deserves. Gall-bladder strictures may be either congenital or acquired, although most observers have considered them as being of acquired origin only. Else bases his opinion that many such deformities are congenital upon his findings in very young infants, one being present in a baby dying within twenty-four hours of birth.

"Uncomplicated congenital strictures in adults can be distinguished by the fact that there is an absence of the evidences of inflammation and by the fact that the characteristics of the congenital strictures differ from those of the acquired type. It is, however, often difficult to differentiate, from acquired strictures, congenital strictures in which changes have taken place due to an infection and gall-stone formation. Congenital strictures predispose to infection and gall-stone formation and these in turn to ulceration and scar formation."

Else classifies congenital strictures into three types

1 Annular strictures

2 Those due to the projection of folds of the inner layers into the lumen

3 The fundus stricture or elbow deformity in which the fundus is folded upon the body of the gall-bladder. This is the most usual type.

Acquired strictures, according to Else, may arise from

1 Destructive lesions beginning with the mucosa. The ulceration and deformity may be due to infection alone or to infection plus pressure necrosis from stones. Constriction varies from that of slight degree to typical hour-glass contraction with almost complete obliteration of the lumen.

2. Intramural infections. These may originate either from infected Luschka ducts or from bacteria or infected emboli brought through the cystic artery.

3 Pathological processes beginning with the serosa The pathological process may be a part of a general or local peritonitis

4 Adhesions existing between the gall-bladder and other organs or the abdominal wall

5 Chronic indurative processes are responsible for strictures as well as for shrunken or so-called atrophic gall-bladders

6 Perforating wounds

7 Malignant strictures

Under the title "Congenital, Almost Complete, Separation of the Gall-bladder into Two Cavities," Morton<sup>3</sup> states that hour-glass gall-bladder is not uncommon In Morton's case the fundus of the gall-bladder formed a pocket consisting of about one-third of the organ which communicated with the proximal part by an extremely minute opening The gall-bladder was of normal size, the wall was not thickened and there was no scar tissue The distal sac contained 50 stones and a little bile, the proximal part was filled with 65 stones Morton quotes Malcolm<sup>4</sup> as reporting a similar condition, but Malcolm believed the constriction in his case to be caused by cicatricial contraction

Fowler<sup>5</sup> notes, also, that hour-glass gall-bladder, *per se*, is not sufficiently rare to warrant extensive report In Fowler's case a stone the size of a hazel-nut and mucopus occupied the upper pocket from which a passage less than one-quarter inch in length, with a quarter inch thick wall, and admitting only a fine probe, led into the lower sac which contained thick, grumous material The lower pocket was larger than the upper and the walls of both were much thickened There were many adhesions about the gall-bladder which rendered cholecystectomy unduly difficult and inadvisable, although indicated There was also a stone in the common duct

The author's case is as follows

Mrs H, aged fifty-seven years, for the past six years has had, annually, one or two attacks of pain in the lower right side which were diagnosed as appendicitis Her bowels have been irregular since childhood She has had stomach trouble during the last six years, off and on, with burning in the stomach and vomiting She ascribed her gastric disturbance to injudicious eating and so starved herself during these attacks She has never had typhoid fever nor has she been pregnant (infantile uterus)

*Pre-operative Examination*—Tenderness was elicited over the appendix Diagnosis, chronic appendicitis

*Operation*—Many adhesions were encountered between the omentum and the peritoneum The appendix showed chronic inflammatory changes and was removed Examination revealed a shrunken gall-bladder containing two stones After separation of adhesions between the liver and the peritoneum the liver was rotated and cholecystectomy performed There were adhesions in the gall-bladder region, but none of the gall-bladder itself Operative recovery has been satisfactory

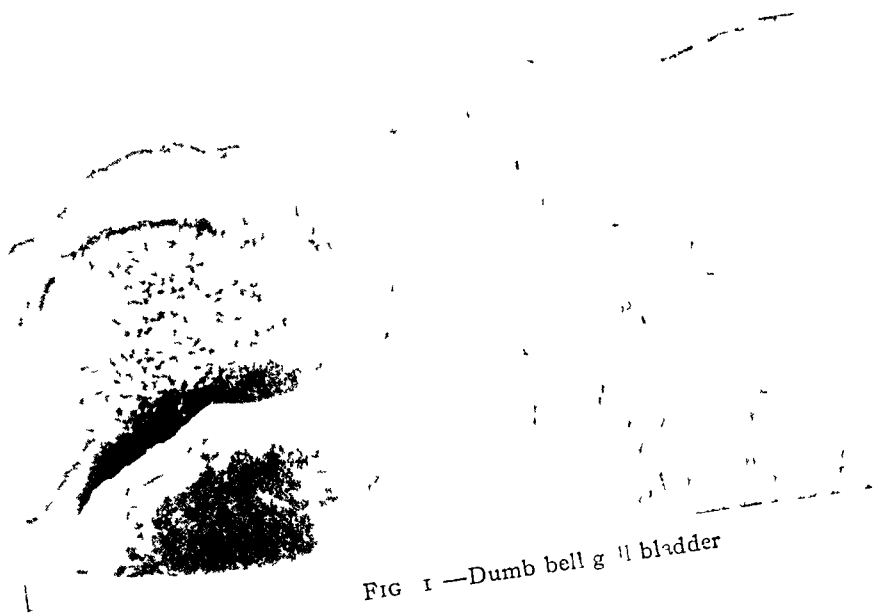


FIG 1 —Dumb bell g " bladder



## STRICTURE OF THE GALL-BLADDER

*Examination of Specimen*—The excised gall-bladder was approximately 7 cm in length. It presented a peculiar appearance. There were two round portions of uniform size, one at the fundus, the other at the neck, with contraction of the part between into a narrow, straight isthmus. The wall was greatly thickened, particularly about the expanded portions, each of which contained a stone the size of a large marble. The lining of these pockets was smooth and white and encircled the stones snugly. The stone at the neck of the gall-bladder was firmly adherent at one point. The gall-bladder contained no bile but merely a few drops of white mucoid fluid characteristic of cystic duct occlusion.

*Comment*—The designation, hour-glass gall-bladder, has been utilized by Else and others to indicate varying degrees of asymmetrical distortions resulting from cicatricial contraction following ulceration. Since the writer's case was characterized by striking symmetry he ventures to suggest, as descriptive of this particular type of deformity, the term, dumb-bell gall-bladder.

From a study of 365 gall-bladders Irwin and MacCarty<sup>6</sup> divide cholecystitis into eight classes, one of which, cholecystitis chronica cystica, is described thus: "A stone was frequently found lodged in the cystic duct or in the valves of the neck of the gall-bladder, thereby causing obstruction and distention of the organ. This resulted in thinning of the wall and destruction of the mucosa or flattening of the scar tissue ridges in the chronic cases. The stone was usually firmly imbedded between the valves and could not be moved in either direction. Microscopically the wall was a thin layer of connective tissue in which traces of the nuclei of the muscle-cells were sometimes found. Such a gall-bladder attained great size and was usually the type which presents itself as a large palpable tumor."

Although differing markedly from the foregoing description, the author's case was undoubtedly one of cholecystitis chronica cystica. The deformity might be classified, according to Else, as one due to chronic indurative processes.

A stone which is apparently impacted in the neck of the gall-bladder (as in the writer's case) in reality may be lodged low down in a dilated cystic duct dangerously close to the hepatic and common ducts. The latter, therefore, should be positively identified.

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# TUMORS OF THE BLADDER

WITH REPORT OF 26 CASES

By H W E WALTHER, M D

OF NEW ORLEANS

THERE is probably no affection coming under the observation of the urologist in which modes of diagnosis and treatment have changed so radically, within the past decennium, as has been noted to have taken place in dealing with neoplasms of the urinary bladder

The final perfecting of the cystoscope and the more extensive use of this valuable instrument *in all cases of hæmaturia* has undoubtedly made it possible to diagnose vesical growths more frequently and at a much earlier period than was formerly the case. Then, too, the histopathological study of these tumors, so thoroughly investigated recently by Buerger, has aided materially towards our determining the character of these growths. Buerger has advocated obtaining material for pathological study by either recovering tumor particles in the bladder washings or by deliberately snipping off a piece of the tumor through an operating cystoscope by means of punch forceps. While the latter method has not been universally accepted, because of the ever-present danger of disseminating malignant cells when dealing with vesical cancer, I believe that when sufficient material can be collected by safer means (as from bladder-washings) it should always be submitted to a competent pathologist for study.

A statement which has repeatedly found its way into print within the past few years is that the clinical diagnosis and the pathologic findings in tumors of the bladder are invariably diametrically opposite. The writer cannot agree with this dictum. To the contrary he has found the clinical diagnosis of a given case repeatedly confirmed by the microscopist and in any number of instances has found the pathologist's opinion of distinct value. Only too few urologists interest themselves in surgical pathology. Were the operator to carefully follow his cases, not only postoperatively in the sick room, but follow specimens removed, to and through the pathological laboratory, he would find the time so spent of inestimable value in perfecting his diagnostic acumen.

Whereas, in the past we have been led to believe that bladder tumors constitute but 3 per cent of all diseases of the urinary organs and from 3 to 7 per cent of all tumors occurring in the human body, one cannot help but feel that with the continued aid of modern urological diagnostic aids, more extensively employed, these figures will require an upward revision.

The one main point in the successful management of these cases, if a cure is to be expected, is an early and a correct diagnosis. Chute has ably pointed out that the tardy recognition of bladder tumors is not due

to a lack of symptoms in most cases, but to a lack of a just appreciation of the significance and importance of symptoms. Of the three cardinal symptoms of vesical growth, viz, hæmaturia, pain and frequency, hæmaturia plays by far the most important rôle. For a number of years past, various urologists have pointed out that hæmaturia is probably the most common early sign of bladder tumor. And yet, as is shown in my personal records, the time which had been allowed to elapse between the first appearance of blood in the urine and the time at which a correct diagnosis was made is perfectly astounding. In two of my cases the interval was fifteen years.

Whether the fault lies with the general practitioner, in failing to send these patients to those properly equipped to make an early diagnosis, or with urologists themselves in their failure to acquaint the general practitioner with the necessity of speedily subjecting every case of hæmaturia to cystoscopy so that these growths can be gotten in their incipency—this is a question I am unable to answer intelligently. However, the propaganda for the dissemination of knowledge in regard to the early diagnosis of cancer, so enthusiastically waged in the past few years by many of our leaders in American surgery, has extended equally into the domain of urology and urological literature, and many valuable contributions have appeared which, if read, should exert no little influence towards making all practitioners of medicine cognizant of the fact that when they are called to see a case of hæmaturia no time should be lost in administering internal medicaments and passing lightly on the occurrence of blood in the urine of their patients. Only too frequently this is the first sign evidenced of cancer.

We know that these bladder tumors may be primary or secondary growths, that they may be benign or malignant. Some writers further divide them into (*a*) epithelial, (*b*) connective-tissue, and (*c*) muscular-tissue tumors. It is generally conceded, I believe, that most benign neoplasms, with few exceptions, arise primarily in the viscus, whilst quite a number of the malignant tumors found in the bladder are metastases from the kidney, or extensions by contiguity from tumors in the prostate and abdominal and pelvic viscera. Of the benign types we commonly see papillomata, angiomas, fibromata, myomata, adenomata and cysts, of the malignant types we get carcinomata, sarcomata and myxomata.

Numerous theories have been expounded regarding the causation of primary bladder growths. Previous inflammation is supposedly a common causative factor. These tumors have been commonly noted among aniline-dye workers. Bilharzia as well as stone in the bladder undoubtedly play a part in the etiology of some cases. Of the secondary growths in the male the prostate must be considered a frequent offender. Montford found in the examination of 78 epithelial tumors in men that 27, or 35 per cent, showed cancerous extension from the prostate. In the female, malignancy of the cervix or of the uterus proper causes a certain percentage of secondary bladder tumors.

The question frequently arises as to when are bladder tumors clinically benign and when are they malignant? Many to-day feel that much confusion



has been caused by referring to benign and malignant papillomata, alluding to the microscopic picture rather than to their clinical course, in giving an impression that we have in the bladder a variety of tumor that is and remains clinically benign. We know such is not the case. That even the most innocent papillomata are potentially or actually malignant. Some writers go as far as to say that the term "benign tumors of the bladder" should be eradicated from our medical nomenclature because of its aptitude towards deception. The consensus of belief to-day is that all tumors of the bladder are clinically malignant and that unless removed by some surgical means will, either directly or indirectly, cause the death of the patient. Particular attention is given to the papillomata because they are by far the most frequent type of neoplasm met with in surgical urology. Of 113 vesical tumors recently studied by Buerger, 55 were papillomata, 45 were papillary carcinomata, 5 were squamous carcinomata, and 6 were sarcomata.

When we come to consider the treatment of this condition we find that opinions have been divided as to what method of procedure best to follow. For many years suprapubic cystotomy with excision of the growth, either by knife or scissors, and then cauterizing tumor base with actual cautery, was the method in vogue. Recurrences rapidly followed all such procedures. Then resection of the tumor with an area of healthy bladder wall, cutting through all the layers of this viscus, was practised, but again implantation of tumor cells and subsequent reappearance of growth at operative site and frequently in suprapubic scar demonstrating that this method was far from ideal. In fact all cutting operations on the bladder for tumor, especially when growth involves trigonal area, have been disappointing. Watson has advocated total cystectomy for extensive malignant involvement of this viscus and has one case that is living and well eighteen years after total removal of the bladder with bilateral nephrostomy. Some few cases of cystectomy have been successfully carried out according to reports recently appearing in the literature. The procedure has not, however, received universal indorsement by urological surgeons. Rafin collected 58 cases of total extirpation in which the operative mortality was 50 per cent. This high death rate at operation undoubtedly accounts for the lack of enthusiasm shown in this procedure. The subtotal cystectomy as advocated by Squier may obtain favor especially in dealing with malignant growths involving only the bladder vertex. For resecting areas of malignancy in the bladder wall the cautery seems to have succeeded the knife, for obvious reasons. Gardner's recently reported collection of 1702 operated bladder tumor cases demonstrates conclusively the limited field of scalpel-surgery for the permanent relief of this condition.

In 1910 Beer first reported his results in destroying papillomatous growths of the bladder by employing high-frequency electrical current in the form of a spark-cauterization directly applied to these neoplasms by means of an electrode introduced into the bladder through an ordinary catheterizing cystoscope. This work has since revolutionized bladder tumor surgery. In the opinion of the writer this monumental work of Beer has

not received the full recognition it so rightly deserves. Surgeons generally do not fully appreciate of what inestimable value this method is to us. When we consider that by intravesical high-frequency cauterization we can, with a few painless applications, cause papillomatous growths to disappear as if by magic and not recur after a careful observation already extending over a period of seven years, and when we again consider the poor results and frequent recurrences in the cases treated by the older methods, we cannot look upon this new way of treatment in any other light than marvellous.

In this high-frequency cauterization procedure two currents have been used. The first one, advocated by Beer, is the Oudin or monopolar spark and is the one most widely used to-day by urologists because of its marked focal action at the point of application producing cauterization and coagulation of tissue. The second current is the d'Arsonval, or bipolar, which has less local action but its distant action, coagulation by heat, is more marked. My experience has been with both types, but I consider the Oudin current far superior to the bipolar method for destroying papillomatous excrescences. Unfortunately, high-frequency cauterization is not applicable for all types of tumor of the bladder. It is generally conceded to-day that it will destroy most papillomata—whether benign or malignant. However, in malignant tumors of a sessile type this treatment is only applicable for the checking of hemorrhage, for it will efficiently stop a bleeding-point with but a short application. As for destroying the malignant growth itself, it has not been found a success.

For malignant vesical neoplasms which in the past have been considered almost beyond any kind of tangible surgical relief, *radium* has opened up a new and fertile field. The possibilities of radium in the treatment of malignant growths have not yet been definitely determined. Surely much good has already been accomplished by its use, and as the action of the element is more thoroughly understood much more good will be accomplished. Among urologists, Young, Barringer and Ayres have published preliminary reports on results obtained with radium in the treatment of cancer of the bladder, particular attention being paid to the inoperable type of malignant bladder growth. Their results obtained so far are indeed encouraging. The applications are made by introducing a capsule of radium, screened with silver and rubber, into the bladder through the sheath of a cystoscope. Some workers have designed special cystoscopes for carrying the radium in the beak of the sheath, as in the Ayres instrument. The most ingenious instruments yet brought forward for this work are the radium cystoscopes of Young. In line with the usual thoroughness to be found in anything that Young attempts, he constructed three different models of radium-carrying cystoscopes, one for making applications to the neck of the bladder, trigone and certain parts of the lateral and posterior vesical walls, a second for treating tumors well out on the lateral walls or on the upper part of the anterior wall, and a third especially adapted for tumors located on the posterior bladder wall. These instruments have been thoroughly tested out by their talented originator in the Brady Urological Institute.

for three years past, and have, in a large series of cases, demonstrated beyond a doubt their practicability

At the Radium Institute of New Orleans a number of cases of advanced malignancy of the bladder have received treatment. The method there of applying the radium has been by placing the capsule in the end of a rubber urethral catheter and then introducing the catheter into the bladder and allowing it to remain for a certain given length of time. The results obtained have been encouraging. However, sufficient time has not elapsed and the number of cases treated to date is not large enough to warrant forming definite conclusions. It is the belief of my colleague, Dr E C Samuel, director of the Institute, that in these cases, in order to obtain the best results, applications should be made preferably through a suprapubic permanent opening.

My reasons for presenting the twenty-six cases of tumor of the bladder which have come under my observation are twofold. Firstly, by reporting my successes with transurethral high-frequency cauterization of vesical papillomata, to add my modest commendation to the procedure introduced by Edwin Beer as being the greatest boon yet rendered to urological surgery in the management of this type of neoplasm. And secondly, to show, by case reports, the futility of scalpel-surgery in dealing with advanced malignant growths of this viscus, when considered from the standpoint of permanent cure. That a new day has dawned and that in the future we shall find in *radium* an agent powerful enough to destroy many of these dreaded growths is a hope that we trust will be fully realized.

CASE I—Mr C D E, railway inspector, thirty-nine years old, was referred to me by Dr J T Nix, Jr, in May, 1913, for bloody urine, frequency, tenesmus and pain in lower mid-back which had extended over a period of four years.

Cystoscopy showed a vesical growth involving entire right side of bladder, right trigonal area and arching half way over anterior wall. Examination was accompanied by so much pain and hemorrhage that limits of growth could not be defined. It was believed that tumor involved entire right half of bladder. Tumor was red, sessile in character, bleeding easily upon touch—typically a carcinomata. Ureteral ostia could not be seen, due to tumor mass and to the dark red, cumulus appearance of the trigonal mucosa. Capacity of bladder 75 c c.

Urine showed heavy trace of albumin, no sugar, trace of indican, no diacetic acid or acetone, no casts, many calcium oxalate and triple phosphate crystals, few uric acid crystals, many epithelial cells, few blood-cells, abundant pus, and many Gram-positive cocci. Wassermann reaction, reported by Dr C C Bass, weakly positive.

General examination showed nothing of note. Prostate slightly enlarged, boggy to the feel and a distinctly indurated area could be palpated in right lobe. Seminal vesicles apparently normal. Urethra admitted a 24 F sound easily.

Potassium iodide internally, and mercury by needle intramuscularly, were given over a period of one month because of the faint suspicion

of syphilis. No improvement whatever occurred. Daily vesical irrigations had also been given during this time.

Suprapubic cystotomy under ether anæsthesia was now done, growth demonstrated to originate from right lateral vesical wall, sessile, about the size of a lime and so adherent to prostate and neighboring structures that resection was considered impossible. A section was taken for the pathologist, the tumor then treated palliatively by paquelinization with actual cautery, destroying as much of the vesical growth as thought expedient, a Pezzer catheter was then put into bladder suprapubically and bladder wall sutured around catheter. Pathologist reported that section showed carcinomata.

A few weeks after operation cystoscopy was done, introducing instrument through suprapubic opening and, noting that growth continued active, two applications of the Oudin high-frequency current were given without any effect on the tumors whatever.

Patient became dissatisfied and consulted another surgeon, who performed an exploratory suprapubic cystotomy, at which he affirmed my diagnosis of inoperable condition in bladder. A right-sided nephrectomy was done by this surgeon later for pyonephrosis. Patient died nine months after my last seeing him, immediate cause of death being exhaustion and sepsis.

*Diagnosis*—Carcinoma of bladder with metastasis to prostate.

CASE II—Mrs. A. O'C., housewife, fifty years old, was referred to me by Dr. W. A. Gillaspie, in November, 1913, for cystoscopy because of patient voiding bloody urine—a condition existent for one month. Patient had experienced only one similar attack of bleeding four years previous, first attack lasting only three days.

Cystoscopy revealing a "chain" of seven small, white papillomata of bladder extending across the viscus behind the left ureteric ostium and parallel to the interureteric bar, none of these tumors were larger than a split pea. Directly on central spot in trigone was a white villous papilloma about the size of a china-ball. It was from the largest tumor in the "chain" group mentioned from which the blood was seen to spurt. Ureteral ostia normal and easily catheterized, revealing normal urine from both kidneys. Bladder mucosa congested in spots on trigone, otherwise normal. Mixed (bladder) urine from catheterized specimen also normal. Wassermann negative, reported by Dr. W. H. Harris. General examination negative.

Three high-frequency cauterizations with Oudin spark in all were required to destroy tumors. The bleeding was arrested with first application of spark. Treatments were given at weekly intervals. Subsequent history uneventful. Cystoscopy in April, 1915, showed no recurrence. No material was obtained for microscopic study, but clinically these tumors were benign papillomata.

Apart from the value of high frequency in this case, an interesting feature to the writer was the length of time which had elapsed (four years) between the first appearance of blood in the urine and the cystoscopy, in that at this examination the tumors found were comparatively small. Was the attack of bleeding four years previous due to these same tumors? If so, these tumors had grown very little, or very slowly, in four years.

*Diagnosis*—Multiple (8) benign papillomata of bladder

CASE III—Mrs M W W, housewife, forty-five years old, was referred to me by Dr C W Allen, in March, 1914, because of "hemorrhage from bladder" which would not respond to the usual treatment. Hæmaturia had been present for two months. No pain or frequency.

Cystoscopy performed during a severe attack of bleeding was unsatisfactory because the bladder could not be washed free of blood-tinged media, and many adherent clots on trigone could not be dislodged, obstructing view of ureteral orifices. Adrenalin used locally to aid in controlling hemorrhage. Bladder capacity 200 c c. A tumor mass in region of right ureteral ostium, about size of a chestnut, was finally seen with its surface apparently villous in appearance. As all attempts to stop hemorrhage by the local procedures usually employed in such cases proved futile, as there was no high-frequency apparatus in the infirmary at which patient was confined, and as patient was beginning to show signs of exsanguination, suprapubic exposure was decided upon as a life-saving measure. Wassermann reported by Dr J A Lanford as negative.

Under ether narcosis Dr C W Allen, assisted by the writer, performed a transperitoneal cystotomy, this route being chosen by the operator so that a thorough examination could be made of all perivesical structures. Bladder opened in the median line and immediately a large quantity of coffee-colored urine admixed with clots was expelled through the incision. After aspirating bladder contents and viscus sponged dry, a single, large papilloma about the size of a lemon was seen to arise from the right lateral wall, behind and external to the right ureter ostium. Tumor was suspended by a pedicle about the size of a small lead pencil. A profuse bloody ooze was seen to be coming from the base of the tumor. Pedicle clamped with two Ochsner clamps, tumor cut away with scalpel and base thoroughly cauterized with Paquelin cautery. Peritoneum closed, the two clamps were left on tumor base to control hemorrhage, several sutures put into bladder wall around clamps, fascia sutured, large rubber-tubing drain being left in bladder suprapubically, muscles approximated and skin only partially closed with silkworm-gut around tube and clamps. Forty-eight hours later clamps were removed. There was no further hemorrhage. Pathologist reported tumor to be a papillary carcinoma.

Subjectively, patient was greatly improved following recovery from operation, but cystoscopy showed that tumor base was "unhealthy" in appearance—resembling recurrence. Five high-frequency cauterizations with Oudin spark to base failed to show any improvement whatever. Patient left for her home in Mississippi.

In October, 1914, seven months after first operation, Dr Allen, assisted by the writer, again did a median section over original scar. Bladder interior now found smooth, clean and in an apparently healing stage at site of original operation. However, in dissecting out the right ureter near the bladder it was found to be thickened and enlarged to the size of an adult thumb, hard to the feel in some portions, while boggy in other parts. The tumor base as well as the lower third of the right ureter was considered by us still malignant. Right ureter was ligated

and cut five inches above its insertion into bladder, and this, with that portion of the bladder wall including right ureteral ostium and the tumor base, was resected *en masse* through all coats of vesical wall and including one and one-half inches of healthy bladder wall surrounding tumor site, so as to be reasonably sure of getting rid of the cancerous infiltration. To accomplish this the right broad ligament was severed and at the same time the right ovary was removed. Peritoneum, fat and muscles brought together with catgut and skin closed with silkworm, cigarette drain being left suprapubically down to bladder and a rubber drain placed through stab wound in vagina to drain abdominal cavity. Pathologist reported tumor-base cicatrix and entire portion of ureter removed to be carcinomatous. This second operation, as the first, was done under ether anaesthesia.

A third operation, eleven days after the second, under local (novocain) anaesthesia was done by Dr. Allen. This was for right-sided nephrectomy. Right kidney proved to be a mere shell—hydronephrosis produced by the carcinomatous ureter on that side, the growth having totally occluded the ureteral lumen. No evidences of malignancy were demonstrated microscopically from sections made from this kidney. Recovery uneventful.

An intravenous phthalein test made two months after last operation to determine status of remaining (left) kidney showed an output of 42 per cent. for two hours. Cystoscopy at this time showed no evidences of recurrence of tumor growth in bladder. Patient has gained thirty pounds in weight and felt fine. Urine showed a trace of albumin, a few pus-cells, and a few Gram-positive cocci.

Since last operation patient reported once every three months for cystoscopy. No further recurrence was noted until September, 1916, nearly two years after last operation, when, at cystoscopy, a small papilloma about the size of a small china-ball was seen to be located in the suprapubic scar, located in the *bas fond*. Two high-frequency cauterizations with Oudin spark thoroughly destroyed this little tumor. The last cystoscopy done in January, 1917, shows bladder free from growth and patient in perfect health.

*Diagnosis*—Papillary carcinoma of bladder and right ureter. Right-sided hydronephrosis, secondary.

CASE IV—Mr. R. B., street-railway conductor, twenty-five years old, came to me in March, 1914, for bloody urine which had been present for six weeks, no pain or frequency.

Cystoscopy showed a single white villous papilloma about the size of a marble situated to inner side and a little behind the right ureteric ostium. The blood was seen to come from the pedicle of the tumor. Rest of bladder normal. Mixed (bladder) urine normal except for excess of blood-cells. Both separate kidney urines normal. Wassermann negative. Phthalein intravenously gave 78 per cent. for two hours. General examination negative.

Two high-frequency cauterizations with Oudin spark, using one-quarter inch spark-gap, completely destroyed the tumor. Bleeding stopped with first application of current. No sections obtainable.

Last observation in February, 1916, nearly two years after treatment, shows bladder still free from growth.

*Diagnosis*—Benign papilloma of bladder (clinically)

CASE V—Mr J L, cooper, sixty-three years old, was referred to me by Dr M E Brown, in June, 1914, because of bloody urine, frequency and pains in urethra and in left side, extending over a period of seven months.

According to patient, he fell from a trestle to the ground (a distance of about ten feet) seven months ago, striking his left side on a projecting piece of timber. Immediately following this accident suffered greatly with pain in left side, began voiding bloody urine and noted that he had to empty bladder frequently. Hæmaturia has continued with few intermissions ever since. Of late has severe pains in urethra during urinations. The patient's history led us to suspect trouble confined to left kidney. Prostate not enlarged, but an induration was felt on left side in region of left seminal vesicle, induration probably in bladder wall.

Physical examination elicited nothing of note. Kidneys not palpable and no tenderness of renal areas, pressure over suprapubic region, however, produced some pain, but nothing could be palpated through abdominal wall. Wassermann negative.

Cystoscopy revealed a sessile tumor in *bas-fond* about the size of a silver dollar, flat, and bleeding from several points. Several grayish blood clots were attached to the tumor. Ureteric ostia could not be recognized due to intense trigonitis.

Repeated high-frequency cauterizations with Oudin spark to arrest the hemorrhage were only partially successful, due to the fact that bleeding was usually so profuse that cystoscopic manipulations were not very satisfactory. Repeated intradermic and intravenous injections of 0.65 gm doses of coagulose failed to check the hemorrhages.

An 18 F soft rubber catheter was placed in urethra to drain bladder continuously—a retention catheter. Bleeding stopped for a few days, but only to return more profusely than ever. Patient in bed all the time.

Under ether anæsthesia the writer performed a suprapubic cystotomy, bladder thoroughly inspected, cystoscopic diagnosis confirmed, a small section removed from tumor aseptically, tumor thoroughly cauterized with Paquelin cautery and bladder closed around a Pezzer catheter, which was left to drain off the urine suprapubically. Hæmaturia never remitted sufficiently to do a phthalein test. Pathologist reported carcinomata.

Within a month after his admission to hospital a definite metastatic infiltration to left lobe of prostate could be felt. Patient became gradually weaker, morphia or pantopon had to be given continuously for pain, and patient succumbed to exhaustion and general sepsis exactly one year after coming under my observation. Due to general condition of patient and to the extent of the cancerous process the case was considered inoperable from the start and the suprapubic paquelinization and drainage were done only to make patient more comfortable. In this we succeeded.

*Diagnosis*—Carcinoma of bladder with metastasis to prostate

CASE VI—Mr V C, engineer, forty-nine years old, was referred to me by Dr E L King, in July, 1914, for bloody urine, frequency

and pains over lower mid-back and suprapubic region which had been existent for two years Impairment in stream for one year also

Cystoscopy demonstrated a papilloma occupying area of left ureteric orifice about size of a chestnut, three small papillomata on left lateral margin of trigone and many (number undetermined) villous-like projections encircling inferior aspect of internal vesical sphincter Right ureter ostium easily recognized, left ostium obstructed by the growth No sections of tumors obtained

Examination showed a poorly developed and nourished white male Nothing of note was found upon physical examination Prostate negative, seminal vesicles not palpable Wassermann, by Dr W H Harris, negative Urine showed a heavy trace albumin, no sugar, many epithelial cells, excess of red blood-cells and leucocytes in proportion to the blood present, no organisms Phthalein test not made on account of excessive bleeding

Eight high-frequency cauterizations in all were required (with Oudin spark) to destroy all the tumors Bleeding ceased with first treatment Treatments were given at five-day intervals

Patient has reported at three-month intervals for cystoscopy Last examination in January, 1917, shows bladder still free from growths

*Diagnosis*—Multiple benign papillomata of bladder (clinically)

CASE VII—Mrs G C, housewife, fifty-three years old, was referred to me by Dr J T Nix, Jr, in January, 1915, for bloody urine and frequency which had existed, intermittently, over a period of two years

Cystoscopy under novocain anæsthesia demonstrated a "bald" sessile tumor about the size of a walnut, located on right lateral vesical wall behind and to the outer side of the spot where right ureteral ostium is normally located Multiple ulcerations with shreds or "tags" of sloughing mucosa appeared upon surface of tumor—some of these areas bleeding freely upon touch Surrounding tumors was an area of œdema bullosum Rest of bladder of a deep red, dull, cumulus appearance—the picture of a severe grade of chronic cystitis Ureters could not be seen

Patient was a very corpulent female, of a highly "neurotic" temperament It was only after much persistence on the part of her physician that she consented to a cystoscopy Rectal palpation negative

Urine was negative except for a few pus-cells, many Gram-negative bacilli, few Gram-positive streptococci and tumor particles Wassermann was negative No examination of tumor made microscopically, but no doubt existed in my mind other than that tumor was malignant She refused operation, even refused a trial treatment with Oudin spark This case did not report back after first cystoscopy and has since been lost sight of

*Diagnosis*—Carcinoma of the bladder (clinically)

CASE VIII—Mrs M J R, housewife, sixty-two years old, referred by Dr E B Liddle, in April, 1915, for bloody urine, frequency, and pains across lower mid-back, over bladder and in her sides, which had persisted for two years

Cystoscopy showed a cluster of four papillomata arising from left



lateral wall of bladder behind and above left ureteral orifice, multiple villous-like projections also encircled internal vesical sphincter Ureteral ostia normal

General examination demonstrated nothing noteworthy Patient said she had lost twenty-five pounds in past four months Urine showed trace of albumin, no sugar, many epithelial cells, many blood-cells, few pus-cells, fair number of Gram-negative bacilli

Nine high-frequency cauterizations in all were given with Oudin spark Bleeding stopped with first application of the current It was found that the tumors about the left ureteral orifice had been totally destroyed, but those at the internal vesical sphincter were still present and it was almost impossible to get the electrode-catheter in such a position as to apply the spark satisfactorily Patient went to her home in Mississippi for a rest and was asked to report back in three months

Upon her return it was found that a recurrence of the tumors on left lateral wall had occurred Two small papillomata were easily destroyed at one sitting

As the high frequency was now considered inadequate for handling tumors involving internal sphincter, suprapubic cystotomy and paquelinization was decided upon as the best means of removing these tumors Accordingly, under ether anæsthesia, Dr J Hume, assisted by Dr S Logan and the writer, exposed the interior of the bladder, demonstrated a single large papilloma the size of a walnut, arising from the left lateral aspect of the vesical sphincter, its base extending into the urethra Tumor was clamped, removed and base freely cauterized with Paquelin cautery Three small tumors on trigone were also destroyed in this way Pezzer catheter left in *per urethram* and bladder closed with three rows of sutures Recovery uneventful This was in October, 1915 Patient has not yet reported back for cystoscopy, but in a letter received recently she states that she has enjoyed perfect health Tumor submitted to pathologist and was reported as benign papillomata by Dr H W Wade

*Diagnosis*—Benign papillomata of bladder

CASE IX—Mr H L, farmer, forty-four years old, seen in conjunction with Dr J Hume and Dr S Logan, came to us for bloody urine, frequency and tenesmus which had existed intermittently over a period of four years

Cystoscopy demonstrated, in the region above and behind the right ureteral ostium, several papillomatous growths, and in the same vicinity were several growths which I considered "bald" or malignant Tumors bled profusely from several points The exact number of tumors was not determined

Patient was first treated in our service by Dr S Logan with high-frequency cauterizations by means of Oudin spark, with only fair results The writer also administered many of these treatments and the results were anything but encouraging However, the bleeding had stopped and patient left the hospital and has since been lost sight of

*Diagnosis*—Carcinoma of bladder (clinically)

CASE X—Mr J M J, painter, sixty-six years old, referred by Dr C. W. Allen, in June, 1915, for bloody urine, slight frequency and pain

in lower abdomen following hard work. This condition had existed for three years.

Cystoscopy, performed after urethral dilatation with sounds because of a stricture at bulbo-membranous juncture, showed three papillomatous tumors and several apparently "bald" tumors involving the whole left side of bladder, including left ureteral ostium. The sessile tumors were ulcerated and bleeding in spots. Left ureter ostium not seen, right easily recognized. Entire bladder mucosa deep red, dull and covered with flakes of pus.

Patient would consent neither to operation nor to a trial treatment with the Oudin high-frequency spark. I had an opportunity of seeing patient only once—at the cystoscopy. Temperature was 102° F. Felt chilly. Had lost fifteen pounds in past year. Urine contained much pus, red blood-cells and many Gram-positive cocci. Some particles of the tumors obtained in bladder washings at the cystoscopy were submitted to pathologist. Dr. H. W. Wade reported papillary carcinomata. Prostate was soft, regular, not painful, not enlarged.

*Diagnosis*—Multiple papillary carcinomata of bladder.

CASE XI—Mr. A. A., Confederate veteran, seventy-three years old, seen in June, 1915, in conjunction with Dr. J. Hume and Dr. S. Logan, came to us for acute retention. For five weeks had been voiding bloody urine and pain in left lower quadrant of abdomen has also been present during this time. Urinary frequency for years.

As the case was urgent no cystoscopy was done. No instrument that could be passed into the bladder *per urethram* gave any relief from the vesical distention due to the thick blood-clots which filled the bladder. The Young clot evacuator was tried, but without result. Suprapubic cystotomy was then decided upon. Under local (novocain) anæsthesia I opened the bladder in the usual manner suprapubically. Bladder was emptied of clots and the Walker retractors inserted so as to inspect inside of viscus thoroughly. Entire left side of bladder and vesical sphincter was found involved in tumor-growth, papillomatous in appearance in some areas while distinctly malignant ("bald"—sessile) in appearance in other areas. Pieces of the tumor were sectioned for pathologist. Neither ureteric ostium seen, but it was thought that only left one was involved in the growth. Tumor mass now thoroughly cauterized as well as possible with Paquelin cautery and Pezzer catheter put in bladder for permanent drainage, bladder wall, muscles and skin closed around catheter. Dr. C. W. Duval reported papillary carcinomata.

This operation relieved patient for a time, the urine became clear to the eye. Patient left hospital two weeks after cystotomy, it being impressed upon him, however, that he should report monthly and that he would have to wear the suprapubic drainage catheter always. Patient was lost sight of for four months. He then returned to hospital in practically a dying condition with a return of the acute urinary retention, he having removed his Pezzer catheter some weeks previously. Under general anæsthesia given by Dr. E. L. King, Dr. Joseph Hume, assisted by the writer, did a second suprapubic cystotomy, the internal vesical sphincter, trigone and left side of bladder con-

taining growth cauterized with Paquelin cautery and large rubber tube put into suprapubic wound for drainage. Death followed within two days, immediate cause of death being surgical shock.

*Diagnosis*—Papillary carcinoma of bladder.

CASE XII—Mr J J D, book-keeper, sixty-two years old, referred by Dr D L Watson, in July, 1915, for bloody urine and pain over bladder region and in mid-lower part of back. This condition had been present for seven months.

Cystoscope introduced with difficulty, due to obstruction at internal vesical sphincter, and causing much pain and bleeding. Bladder markedly trabeculated, right lobe prostatic projection marked, right ureteric ostium normal—left one not seen. Covering entire left lateral, superior and trigonal regions of bladder was seen a tumor mass, ulcerated, necrotic in spots, bleeding from other points. At times filaments of growth dropped over cystoscopic lens, totally obstructing view. Bladder capacity 150 c c.

General examination showed nothing of note. Prostate *per rectum* not enlarged, soft, regular, not tender, seminal vesicles not palpable. Base of bladder by rectal feel gave no definite evidences of infiltration.

All surgical aid was refused by patient. Also refused Oudin cauterization. Patient was lost sight of, but Dr Watson has kindly reported to me that in March, 1916, eight months after my seeing case, patient died—most probably from metastases from vesical carcinoma.

*Diagnosis*—Carcinoma of bladder (clinically).

CASE XIII—Mr L M, sixty-eight years old, photographer, seen in August, 1915, in conjunction with Dr J Hume and Dr S Logan, complaining of urinary frequency, bloody urine and tenesmus, no pain. This condition has been present for six months.

Cystoscopy revealed an extensive papillomatous tumor covering entire left lateral wall of bladder, brownish in color due to blood, area of tumor including left ureteral orifice. Right ostium easily seen and normal. Entire bladder interior congested. Capacity 250 c c. Blood seemed to be coming from a portion of the growth just at the left lateral aspect of internal vesical sphincter.

Urine showed heavy trace albumin, no sugar, few epithelia, blood in excess, fair amount of pus, many fine Gram-positive bacilli, cocci and streptococci. General examination negative. Prostate normal. Wassermann negative.

Three high-frequency treatments with Oudin spark thoroughly destroyed this tumor. During treatments patient developed a marked alkaline cystitis, he was given bladder instillations of a sugar-water mixture of Bulgarian lactic acid bacilli and the cystitis promptly responded to this treatment. Last cystoscopy, in April, 1916, eight months after treatment, shows bladder still free of growth. Sections from bladder washings reported at the time by Dr M J Couret to be benign papillomata.

*Diagnosis*—Benign papillomata of bladder.

CASE XIV—Mrs M E, sixty-five years old, referred by Dr C W Allen, in February, 1916, for bloody urine, frequency, burning and pain over bladder region. Condition existent, intermittently, for past twelve years.

## TUMORS OF THE BLADDER

Cystoscopy revealed a sessile tumor about the size of a silver quarter-dollar, covering entire left half of trigone and left ureteric region, bleeding in spots. Markedly contracted bladder, holding 50 c c fluid, mucosa dark red and dull, with adherent flakes of pus in spots. Ureteric ostia not seen.

Urine showed heavy albumin, no sugar, few epithelia, few red blood-cells, much pus and Gram-negative bacilli. General examination negative. Wassermann negative. Intravenous phthalein test showed 16 per cent in two hours.

Under novocain anæsthesia, Dr C W Allen, assisted by the writer, did suprapubic cystotomy, exposed a hard, infiltrated, sessile growth on trigone typically carcinoma. Bladder much contracted, about size of a lime, and was exposed with difficulty. Anæsthesia, however, was complete. Growth thoroughly cauterized with Paquelin cautery, bladder closed around an indwelling Pezzer catheter. Suprapubic wound packed with iodoform gauze, skin and muscles not sutured. Operation lasted thirty minutes. Due to the age and physical condition of patient it was not thought advisable to do more than this. No sections obtained for pathologist.

Patient did well for one month, was allowed to return to her home in Mississippi. Death occurred seven weeks after operation from exhaustion and cardiac failure, according to the report of her family physician.

*Diagnosis*—Carcinoma of bladder (clinically)

CASE XV—Mr G W H, farmer, aged sixty-three, consulted me in March, 1916, for constant pain in bladder, marked frequency and bloody urine. First hæmaturia attack fifteen years ago, this bleeding has persisted intermittently ever since.

Cystoscopy showed entire left lateral wall of bladder included in a sessile, ulcerating growth apparently arising from a point behind and above the left ureteral orifice. Tumor invades left half of trigone also. Ureteral ostia not seen. Prostatic margin irregular, but no marked intravesical projection.

Urine showed much pus and many Gram-negative bacilli, only an occasional red blood-cell. General examination negative except that left lobe of prostate, per rectum, felt much enlarged, smooth, stony-hard to the feel. Right lobe not involved apparently. Left seminal vesicle matted with prostatic lobe on same side and very hard. Right vesicle not palpable. Wassermann negative. Intravenous phthalein test showed 48 per cent for two hours.

Under novocain anæsthesia suprapubic cystotomy was done and inside of bladder thoroughly inspected by aid of Masson retractor. An infiltrating growth about size of half-dollar was seen located behind and to the outer side of left ureteral orifice. Tumor involves all layers of bladder and includes prostate on that (left) side. As tumor was encroaching upon internal vesical sphincter, it was cauterized with Paquelin as thoroughly as possible, Pezzer catheter retained in suprapubic wound and incision closed by layers.

The patient was up and out of the hospital within two weeks, voiding freely, no blood or pain. This would have been a case where

radium might have helped, but none was available. He did well for six months, but due to recurrence and metastases, finally succumbed.

*Diagnosis*—Carcinoma of bladder, carcinoma of prostate, carcinoma of seminal vesicles (clinically)

CASE XVI—Mr A L, brakeman, forty-six years old, referred by Dr F J Spellman, in March, 1916, for bloody urine, pain in bladder and frequency. Hæmaturia present for one year. Is now unable to void at all.

Cystoscope was introduced with difficulty due to strictured vesical neck. Prostatic margin irregular, but no intravesical projection. The left half of trigone, left lateral wall of bladder and left ureteral orifice region was occupied by a tumor mass, sessile in areas while papillomatous in other spots. Entire mass was undergoing degeneration. Bleeding seen to come from internal vesical sphincter region. Ureteric ostia not seen. Bladder capacity 125 c c.

Physical examination negative except for prostate. Left lateral prostatic lobe much enlarged, stony, hard, the seminal vesicle on the left was involved in this process, being hard and enlarged also. Left lobe of prostate and left seminal vesicle normal to the feel. Urine showed heavy trace albumin, no sugar, few epithelia, excess of red blood-cells and pus, many Gram-positive diplococci. Intravenous phthalein 15 per cent excreted in two hours. Wassermann negative.

Under novocain anæsthesia suprapubic cystotomy was done, tumor mass well cauterized with Paquelin and Pezzer catheter drainage established suprapubically. As prostate and vesicles were involved, and as patient was very weak physically, it was decided by all who saw him that this was the most that could be done at this late stage of the disease. From last reports he is still alive and comfortable.

*Diagnosis*—Carcinoma of bladder, carcinoma of prostate secondary, carcinoma of seminal vesicles secondary (clinically)

CASE XVII—Mr A S A, journalist, aged fifty-six, referred by Dr W A Love, in April, 1916, complained of frequency, burning, difficulty. No hæmaturia. Chronic constipation for one year. Frequency and difficulty present for fifteen years.

Cystoscopy, attempted upon two different occasions, was found impossible, due to the size of the prostate or the marked obstruction at the internal vesical sphincter.

Urine showed a trace of albumin, no sugar, few epithelia, no blood, much pus and many Gram-positive diplococci. Urine voided only in drops. General physical examination showed nothing of note. Per rectum, prostate was found to be the size of a grape-fruit and stony-hard. Seminal vesicles so matted in the process as to be indistinguishable from prostatic tumor. Beyond prostate a circular mass involves rectal lumen, leaving an opening in bowel hardly large enough to admit little finger. Wassermann negative. Phthalein intravenously read 59 per cent for two hours.

Proctoscopy revealed an annular stricture in rectum, seen to be about four inches from sphincter of anus, very suspicious in appearance of malignancy of the bowel.

As his urinary stream shut down completely a few days after first

seeing him, patient was admitted to hospital and, as no instruments could be introduced by the urethra, suprapubic cystotomy was done under novocain anæsthesia, assisted by Dr H J Lindner Prostatic projection into bladder, small but stony-hard, covered with multiple small bosses or tubercles Internal vesical sphincter contracted and completely involved in a sessile growth which had practically closed the vesical outlet A clear view of all structures could not be obtained, due to the depth of the bladder and the straining by the patient Growth at vesical neck thoroughly cauterized with Paquelin, bladder outlet reestablished and an indwelling catheter placed in urethra Pezzer put in suprapubically Bladder closed Left hospital within ten days, the urethral catheter had to be removed because of irritation Suprapubic Pezzer remained, however Has never been able to void satisfactorily, however, *per urethram*

Dr C W Allen was requested to see this case by me and he confirmed my diagnosis of malignancy of bladder, prostate and vesicles The case had gone too far to attempt anything radical

Three months after operation he was still comfortable with the suprapubic drainage and was having no trouble while at stool He left for his home in San Francisco and has not been heard of since

*Diagnosis*—Carcinoma of bladder, carcinoma of prostate, carcinoma of seminal vesicles (clinically)

CASE XVIII—Mr F M, painter, aged fifty-eight, consulted me in June, 1916, for bloody urine, frequency and pain in bladder region during and after each urination, these symptoms having existed intermittently for two years past

Cystoscopy showed entire right lateral wall of bladder, right trigonal area and right vertex region occupied by a large, sessile, ulcerated tumor with jagged edges, bleeding in spots No villi seen Left lateral lobe of prostate enlarged Ureteral orifices could not be seen

Urine showed heavy albumin, no sugar, many epithelia, no casts, excess of pus and red blood-cells, few Gram-negative bacilli Wassermann negative Intravenous phthalein for two hours gave 65 per cent General examination revealed bad teeth, anæmic generally, kidneys not palpable, marked tenderness to pressure over suprapubic region but no mass felt, reflexes sluggish Prostate and seminal vesicles soft and small, no evidences of malignancy On right side above right seminal vesicle area the base of the bladder feels bulging and doughy, suggesting tumor within viscus

Patient put to bed with indwelling urethral catheter tried, but catheter seemed to increase rather than to check bleeding High-frequency cauterization attempted twice with Oudin current to control hemorrhage, but in this was only partially successful Tumor was not in a position to treat satisfactorily by this method

June 21, 1916, suprapubic cystotomy under ether anæsthesia Bladder interior freely exposed by Masson bladder retractor A large, sessile, "mushy," ulcerating tumor seen to spring from internal vesical sphincter, very fragile, and seems to extend into posterior urethra Tumor thoroughly cauterized with Paquelin, including base Pezzer catheter drainage instituted from above, bladder and suprapubic

wound closed around catheter. Several portions of the tumor submitted to Dr M Couret, pathologist, were reported to be carcinoma. Due to fact that growth involved entire trigone, that the patient was fifty-eight years old and very weak from loss of blood, it was deemed unwise to attempt resection or cystectomy.

Patient did well for a while, but metastasis occurred in the suprapubic wound, he grew generally weaker and died July 11, 1916, almost three weeks after the operation, of exhaustion.

*Diagnosis*—Carcinoma of the bladder.

CASE XIX—Mr J H, saw-mill worker, aged sixty-seven, consulted me in June, 1916, for bloody urine, marked frequency, poor stream and burning, symptoms being present for only one month.

Cystoscopy revealed a tumor occupying entire right side bladder, right ureteric orifice, tumor, size of a walnut, "bald," small ulcerations noted over its surface. Several small diverticula seen in *bas-fond*. Entire bladder trabeculated. Left ureteral orifice normal in size and shape.

Urine showed trace albumin, no sugar, many epithelia, no casts, many pus and red blood-cells, many Gram-negative bacilli and Gram-positive cocci. Smear from urethra showed only pus cells. Smear from prostatic secretion showed much pus and Gram-positive cocci. Wassermann negative. General examination revealed a left inguinal hernia, prostate enlarged, firm, regular, no nodules or irregularities to suggest malignancy.

This case was clinically a carcinoma of the bladder, but it was suggested to patient that he try high-frequency cauterizations with Oudin spark to control hemorrhage and later submit to a suprapubic cystotomy. Patient refused to submit either to further cystoscopic treatments or operation and was lost sight of shortly afterwards.

*Diagnosis*—Carcinoma of bladder (clinically).

CASE XX—Mr A C, farmer, seventy years old, consulted me in July, 1916, for urinary frequency, burning and bloody urine, the symptoms being present intermittently for two years past.

Due to profuse hemorrhage, the excessive formation of clots in bladder and to weakened condition of patient cystoscopy was not attempted. Urine showed heavy albumin, no sugar, few epithelia, excess of red blood-cells, much pus and many Gram-positive cocci. Prostate hard, enlarged, painful, but no nodules.

One week after seeing patient, the hemorrhage still persisting, suprapubic cystotomy under ether anæsthesia was done and a large fungoid carcinoma of right side of bladder was seen, involving and adherent to the right portion of the prostate. Condition recognized as inoperable, Pezzer catheter retained as drainage from above and bladder closed. Tumor sections were removed and partial cauterization attempted. Pathologist reported carcinoma.

Patient left hospital one month after operation more comfortable with suprapubic drainage of bladder and was lost sight of.

*Diagnosis*—Carcinoma of bladder involving prostate.

CASE XXI—Mr N G, fisherman, aged seventy, seen in September, 1916, in conjunction with Dr J Hume and Dr S Logan, complained

of bloody urine, pain in left lower part of back and urinary frequency  
 Trouble present eleven months

Cystoscopy showed entire left side of bladder, including ureteral orifice area and internal sphincter, involved in a tumor mass, smooth, sessile, and about the size of an egg, dark red to brown, not bleeding  
 Prostate not enlarged

Urine showed trace albumin, no sugar, few epithelia, much pus and blood, many bacilli and cocci. No tubercle bacilli. Wassermann negative. X-ray examination of entire urinary tract negative. Intravenous phthalein for two hours gave 5 per cent.

Three high-frequency cauterizations with Oudin spark gave no results. Due to poor general condition operation was not advised. No radium was available. Patient sent home.

*Diagnosis*—Carcinoma of bladder (clinically)

CASE XXII—Mr P M A, boiler-maker, thirty-nine years old, seen in conjunction with Dr H J Lindner in September, 1916, with bloody urine, some frequency, and difficulty in urinating. Blood present for only three weeks.

Cystoscopy showed a smooth, round, "bald" tumor about size of a lime occupying right ureteral orifice region and right side of internal vesical sphincter, bleeding easily upon touch, in some spots papillomatous excrescences seen. A clot covered part of the tumor which could not be dislodged. Entire bladder dull, dark red with *bas fond* trabeculated. Right ureteral orifice not seen but left visible and normal.

Urine showed trace albumin, no sugar, few epithelia, much pus and blood, many cocci and bacilli. Wassermann negative. General examination negative. Prostate not enlarged, soft, regular, tender. Seminal vesicles not palpable. Nine high-frequency cauterizations with Oudin spark given tumor. Hemorrhage stopped for a time and then high-frequency had no more effect. Tumor apparently stimulated to further growth by Oudin spark.

Suprapubic cystotomy finally done under general anæsthesia and growth destroyed as well as practical by means of paquelinization. Growth found at operation to extend well into external vesical sphincter and involve entire vesical trigone. Large Freyer tube left in suprapubic opening because radium applications will be attempted through this opening. Patient's condition improved, hemorrhage stopped. Patient still under observation.

*Diagnosis*—Carcinoma of bladder

CASE XXIII—Miss M L, cook, aged fifty-six years, seen in conjunction with Dr J Hume and Dr S Logan, in December, 1916, complaining of frequency and bloody urine, the condition being present only five months.

Cystoscopy revealed a single papillomatous tumor on left lateral superior wall of bladder the size of a hazelnut with a very small pedicle. Rest of bladder including ureteral orifices normal. Kidney urines negative.

Urine showed trace albumin, no sugar, few epithelia, few red blood-cells, few pus cells and many Gram-negative bacilli. Wassermann negative. General examination negative. Piece of tumor reported by pathologist benign papilloma.



Tumor totally destroyed in three applications of high-frequency cautery by Oudin spark. Last cystoscopy April 15, 1917, shows no recurrence of growth, but entire left lateral trigonal area presents condition of bulbous oedema. Is this a sign of recurrence?

*Diagnosis*—Benign papilloma of bladder

CASE XXIV—Mr J C, elevator tender, aged forty-six years, seen in conjunction with Dr J Hume and Dr S Logan in December, 1916, suffering with pain in bladder, marked frequency and bloody urine, a condition present for one year.

Cystoscopy made by Dr. P J Gelpi revealed two tumors in right lateral portion of bladder, one on trigone behind right ureter and other to the right of internal sphincter. Both tumors were typically papillomata and were treated twice a week for a period of six months. Bleeding stopped after first application of Oudin spark. Both tumors were apparently destroyed by high-frequency current according to Beer. This occurred six months before patient was admitted to our service. Just before admittance to hospital Dr Gelpi again cystoscoped patient and discovered that tumors now filled entire bladder, were sessile, and bleeding from many points.

Patient was so anæmic and emaciated upon entering hospital that nothing was done but to put patient to bed and indwelling catheter, 18 F, put in urethra so as to drain bladder. 50 c c foul, bloody urine drawn off. Bladder irrigated with warm weak silver solution daily. Wassermann negative.

Urine showed heavy albumin, no sugar, few epithelia, many red blood-cells, much pus, many Gram-positive cocci and Gram-negative bacilli. When urine cleared a phthalein was done intravenously and showed 2.5 per cent for two hours.

Entire suprapubic region was markedly infiltrated with hard growth almost up to and under skin of abdomen. Prostate very large and stony-hard, left lateral lobe being larger than right. Seminal vesicles not palpable.

Patient died from exhaustion two weeks after entering hospital.

*Diagnosis*—Carcinoma of bladder, malignant metastasis to prostate.

CASE XXV—Mr J H, fireman, aged forty-nine years, consulted me in January, 1917, for bloody urine, frequency, burning and urgency—all these symptoms present for only one month.

Cystoscopy showed entire left side of internal vesical sphincter involved in a white, papillomatous mass with areas of sloughing and bleeding in spots. Marked inflammation of entire bladder mucosa, ureteral orifices could not be seen. Cystoscope was introduced with some difficulty, there being a marked narrowing of the urethra, a bladder neck and posterior urethra juncture—probably malignant infiltration.

Urine showed trace albumin, no sugar, many epithelia, much pus and red blood-cells, many Gram-positive cocci and bacilli. Patient's teeth very bad, general examination otherwise negative. Wassermann negative.

## TUMORS OF THE BLADDER

An interesting phase of this case was that seven months before my cystoscopying him he had a prostatectomy performed. It is evident from what his physician told him that there was no tumor in the bladder at that time. But no pathological examination was made of prostate removed suprapubically. This gland was most probably malignant and in removing same malignant cells were implanted in the edges of the capsule with a resulting malignancy of the bladder.

Several high-frequency cauterizations were made to tumor with Oudin spark, but without effect except to check hemorrhage. The growth was seen to enlarge in size at every succeeding cystoscopy. Pieces of tissue were reported papillary carcinomata by pathologist.

Under ether anæsthesia suprapubic cystotomy was done and paquelinization of growth carried out as thoroughly as possible. Left ureteral orifice, entire trigone and internal vesical sphincter involved in growth. Growth practically occluding vesical outlet. Pezzer catheter put in from above for permanent drainage. Radium advised, but patient left city and has been lost sight of.

*Diagnosis*—Papillary carcinoma of bladder probably secondary to malignancy of prostate.

CASE XXVI—Mr I A G, barkeeper, aged fifty years, consulted me in January, 1917, for bloody urine, frequency and difficulty—a condition which had been present for one month. Thinks he has had a "stricture" for thirty years. Urinary stream poor for five years. No pains nor aches.

Cystoscopy shows a small papilloma to outer side right ureteral orifice and also multiple papillomata involving internal vesical sphincter. Bleeding comes from growths in bladder neck. Ureters easily seen and catheterized without trouble, both kidney urines sterile. Bladder mucosa otherwise normal. Pieces of tumor reported by pathologist benign papillomata.

Urine heavy albumin, no sugar, trace phosphates, few epithelia, much blood and pus, many Gram-positive cocci. Wassermann negative. X-ray of genito-urinary tract negative for stone. Teeth bad, general examination otherwise negative. Prostate moderately enlarged, soft, not nodular, smooth, not tender. Seminal vesicles not palpable.

One high-frequency cauterization with Oudin spark destroyed the tumor at the right ureteric ostium, several applications of spark to internal vesical sphincter failed to thoroughly destroy these growths due to their position. Following the advice of Beer in this type of case the bladder was therefore opened suprapubically under local (novocain) anæsthesia and with a Paquelin cautery the tumors were completely destroyed at the bladder neck and in posterior urethra. The Masson bladder retractor was of much benefit here in giving the operator a good exposure on vesical interior including internal sphincter region. Bladder closed without drainage. Recovery uneventful. Case still under observation.

*Diagnosis*—Benign papillomata of bladder.

# INGUINAL HERNIA IN THE MALE\*

WITH REGARD TO POST-OPERATIVE SEQUELÆ

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(From the Second Surgical Division, New York Hospital)

WITH the aid of the excellent Follow-up System in operation on Dr E H Pool's service at the New York Hospital, the writer has been enabled to make an intensive study of the after-results of operation in 148 cases of inguinal hernia in the male

This series is a consecutive one of all the operations for inguinal hernia performed on the Second Surgical Division of the New York Hospital during the given period, except for the necessary exclusion of 13 patients of whom no trace could be obtained after leaving the hospital and the omission from present consideration of all cases in the female

The last case in the series was operated over eight months ago, and the earlier ones have been followed for a year and a half

Hydrocele of the tunica followed herniotomy in 20 cases, or 13.4 per cent, and attention may well be drawn to this sequela, about which very little has been written

Bloodgood (*Johns Hopkins Hosp Reports*, vol vii), in speaking of the results following the old Halsted operation, with wide transplantation of the cord straight out through the aponeurosis, says that hydrocele occurred in 20 per cent of the cases where venectomy was done with a view to reducing the size of the cord, but occurred in only 3 per cent where the veins were not removed. He lays great stress upon not dividing all of the mesocord, or bed of the cord

The natural inference from Bloodgood's observation is that venous stasis, following venectomy, is a cause of hydrocele, but with this inference we are not in entire accord, and for the following reasons

1 In 30 consecutive venectomies for varicocele, only one case developed post-operative hydrocele

2 In 78 cases of hydrocele, only 3 cases had coexistent varicocele, and 3 others were results of previous varicocele operations

3 Venous stasis is much more frequent on the left side than upon the right, as evidenced by the greater frequency of varicocele on the left (over 90 per cent), but hydrocele is not more frequent on the left than on the right, there being 39 of each kind in a series of 78 cases

However, the relationship between hydrocele and inguinal hernia is a very real one and, to the writer, assumes the rôle of greatest interest in this study

At once we are impelled to distinguish sharply between the two types of

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\* Read before the N Y Surgical Society, October 10, 1917

## INGUINAL HERNIA IN THE MALE

hernia, oblique and direct, for we find that it is the oblique hernia which is associated with hydrocele

TABLE I  
TABULATION OF 148 OPERATIONS FOR INGUINAL HERNIA

	Number of individuals	Number of operations	Age at operation	Right side	Left side	Bilateral	Operation for recurrence	With co-existent hydrocele
Oblique hernia	91	102	years 27 6	65	37	12	4	13
Direct hernia	29	46	36	24	22	17	5	0
Total	120	148		89	59	29	9	13

We have mentioned that in our series of 148 cases there developed 20 hydroceles as a sequela of the operation, 18 of these following oblique hernia, only 2 following direct hernia

Is the hydrocele thus developed of any lasting importance or is it to be early and completely absorbed?

In 7 instances the hydrocele had entirely disappeared in less than three months, in 1 other case it disappeared between four and six months, nevertheless, we are confronted with 12 postoperative hydroceles which have persisted over six months without receding and which are probably permanent

There are therefore 12 persistent hydroceles following 148 operations, or 8.1 per cent, 10 of these followed 102 oblique herniæ or 10.2 per cent, and 2 followed 46 direct herniæ, or 4.3 per cent

If the assumption be true that hernia operations are a cause of persistent hydrocele, which fact is not commonly stated in treatises on hydrocele, then one should find this evidence upon reviewing a series of cases admitted for the relief of hydrocele (see Table II).

TABLE II  
ETIOLOGY IN SIXTY CONSECUTIVE HYDROCELE OPERATIONS

13 cases followed herniotomy, from 1 to 10 years before  
 13 cases were admitted with coexistent oblique herniæ  
 0 cases were admitted with coexistent direct hernia  
 3 cases followed operation for varicocele  
 5 cases followed operation for inguinal adenitis  
 1 case was recurrent after a hydrocele operation  
 13 cases resulted from trauma or occurred spontaneously  
 12 histories do not mention any previous operation, but neither do they exclude it

60

Here we find that more than 21 per cent of all hydroceles presenting for operation followed herniotomy on the same side, and that another 21 per cent were found coexistent with oblique herniæ, but never with direct hernia

The hydrocele is not merely a matter of venous stasis nor of the type of repair of the inguinal canal, for exactly similar conditions would exist after

operations for either oblique or direct hernia, if one uses the Bassini in both instances, but hydrocele is definitely a matter concerning the anatomical position and type of hernial sac and its operative treatment

#### TYPES OF INGUINAL HERNIA

In our series (see Table I) oblique herniæ occurred twice more frequently than direct, 102 oblique, and 46 direct

There were 12 operations for bilateral oblique hernia, but when we include those individuals in whom a previous operation had been performed upon the other side, or where there has been shown at the "Follow-up" that a hernia exists on the other side, we must add 7 individuals, making a total incidence of bilateral oblique hernia 19 times among 91 patients, or over 20 per cent

In the series of 102 oblique operations there was a great preponderance of right side over left, 65 right, 37 left, for which we offer no explanation

In 13 cases the sac was of the congenital type, and in 18 cases it was definitely described as of the funicular process type. There were a number of others in which the length and extreme narrowness of the sac strongly suggest the funicular type, although the operator did not so call them

One may therefore conservatively state that more than one-third of the 102 oblique herniæ presented sacs of a developmental character, which lends weight to the claim of some writers that all oblique herniæ exist as potential sacs from birth

The average age at operation for oblique hernia was 27.6 years. Of the 91 individuals, 30 were under twenty years of age, and among the latter there were 24 distinctly funicular or congenital sacs

Whence it appears that more than three-quarters of all herniæ operated upon before the age of twenty years were of developmental type, which again favors the claim that oblique herniæ are developmental in origin

Hydrocele of the cord, or tunica, or both, was found associated with oblique hernia in thirteen instances at operation, but in no instance associated with direct hernia

Associated with 9 of these hydroceles, the hernial sac was of developmental type, 1 congenital, and 8 funicular process sacs

There were 2 cases of hydrocele of the cord, 7 cases of hydrocele of the tunica, 4 cases of both cord and tunica

Hydrocele of the cord represents imperfect closure of the funicular process and is probably always accompanied by a small potential hernial sac

From our statistics we may conclude that the presence of hydrocele of either tunica or cord, on the same side as a hernia, will point to the diagnosis of oblique hernia of either the funicular or congenital type

#### DIRECT HERNIA

These herniæ were more often bilateral than unilateral, 18 instances among 29 individuals, or 62 per cent

## INGUINAL HERNIA IN THE MALE

The average age at operation was thirty-six years, and the youngest individual was aged twenty-three years, which is consonant with our belief that direct herniæ are acquired, and do not exist as potentialities from birth or else they would develop earlier in life

Among explanations of the etiology of direct hernia, we may venture the following Congenitally weak aponeurosis and lower abdominal muscles, narrow lower rectus, atony and relaxation of the lower abdominal muscles due to disease, malnutrition, or to faulty postural attitude in standing, but in many other cases the general nutrition and muscle tone are above reproach and it is in these latter cases that we find the increase of peritoneal fat which seems to have wedged its way forward through a vascular interstice in the transversalis fascia and to have been followed by the peritoneal sac, as occurs in epigastric hernia

Hydrocele which we have seen is so often associated with oblique hernia was not found associated with any one of our 46 direct herniæ, and but 2 hydroceles developed following operation for direct hernia

### DIRECT-INDIRECT HERNIA

There were 10 instances where the sac was found to bulge on both sides of the deep epigastric vessels, thus forming combined, direct and indirect herniæ, also spoken of as double or "saddle-bag" herniæ

These have been counted with the direct herniæ, of which type they seem to be modifications or lateral extensions

Our reasons for so classifying them are the following.

(a) In all 10 of the cases the direct hernia constituted the major factor, the sac to the outer side of the epigastrics was usually described simply as a bulging

(b) All 10 of the cases occurred in bilateral herniæ, including 3 individuals with bilateral direct-indirect hernia, 3 individuals with direct-indirect hernia on one side and with direct hernia on the other, one individual with direct-indirect hernia on one side but presenting a repaired hernia on the other side, of type unknown (presumably the same?)

(c) In no instance of the 10 was there found an oblique hernia on the one side and a direct-indirect on the other, in other words, they were found associated only with direct hernia and never with oblique

(d) No hydroceles were encountered in association with the direct-indirect herniæ

Hence we group the direct-indirect herniæ with the directs and not with the obliques, because of their many similarities to directs

In the whole series of 148 cases we came upon no instance of a direct hernia upon one side and a true oblique on the other, and we conclude that when herniæ are bilateral, they are of the same general type on the two sides

## SEQUELÆ OF OPERATION

*Post-operative Tumefactions in the Scrotum*—Throughout the entire series painstaking notes were made of the local condition as found on digital examination, both during the hospital residence of the patients and months later through the Follow-up examinations

The bedside notes reveal 56 instances of demonstrable adventitious swellings immediately following operation, an incidence of 37.9 per cent for the series

These swellings were much more frequent following oblique hernia operations, 48 per cent, whereas after direct operations there were 15.2 per cent

Inasmuch as trauma of dissection and mechanical rearrangement of the scrotal tissues is the admitted cause of most of these swellings, it is easy to see why they occur more often after oblique than after direct operations, for except in the cases of very large direct hernia there is seldom necessary any dissection in the scrotum, or of the cord itself, for the direct sac does not involve the cord or tunica, nor in most cases does the sac enter the scrotum

An attempt to classify these post-operative tumefactions is necessarily somewhat conjectural, but is based upon their location, consistency, and in nearly every case of hydrocele by transillumination and by needle aspiration

The hydroceles when first observed, a few days after operation, were usually small collections of fluid which might readily have escaped the casual observer, but upon aspiration would yield from 20 to 60 c c of straw-colored fluid

The veins referred to as thrombosed were palpable as discrete oval or knot-like indurations along the cord in cases where venectomy had been performed and the ligated stumps approximated

Distention of veins in the cord above the testis was met with in cases after venectomy and in other cases where probably the canal repair had caused some obstruction to the venous circulation, but all of these cases cleared up after a few weeks

The *tunica* thickenings, so-called, followed operations on the tunica and existed for some months or permanently as palpable fibrous thickenings usually behind and above the testis, and are explained by the mechanical rearrangement of the tunic after the Andrews, Winkelmann and other hydrocele operations

*Hæmatomata* varied in size from a walnut to a distention of the whole half of the scrotum, spreading in the loose connective tissue beneath the dartos. Resolution was usually quite complete within three months, but some permanent fibrosis was left in half of the cases

The unidentified indurations of the cord and of the testis were probably results of œdema or extravasation following scrotal dissection, most of these resolved within a few months, but in one case where there had been imme-

# INGUINAL HERNIA IN THE MALE

date and marked swelling of the testis (without fluid) the testis was found quite atrophied when examined a few months after operation

TABLE III  
POST-OPERATIVE TUMEFACTIONS

	Number of operations	Hydroceles	Thrombosed veins	Distended veins	Tunica thickening	Hæmatoma	Induration of cord	Induration of testis	Total number	Percentage
Oblique	102									
Early		18	5	6	11	6	4	3	49	48
Persistent		10	4	0	4	3	2	0	23	22 5
Direct	46									
Early		2	0	0	0	0	2	3	7	15 2
Persistent		2	0	0	0	0	1	1	4	8 7

N B In obliques there were 4 instances where two different swellings were recognized in one case, thus 53 swellings in 49 cases

Many of the tumefactions noted above are of little more than academic interest and may be considered merely as necessary concomitants of scrotal dissection, hydrocele operations, venectomy, and, in less than three months, more than half of them have entirely disappeared Or even if they persist as some slight thickening along the cord or about the testis most of them give rise to no subjective symptoms

Thus we may dismiss without further discussion the tumefactions classed above as hæmatoma, tunica thickenings, distended and thrombosed veins, and indeed most of the unidentified indurations of the testis and cord

Nevertheless, we have remaining, as persistent to date, 12 hydroceles which are of much greater import

To tabulate 48 per cent of postoperative tumefactions following 102 oblique hernia operations seems rather startling until one considers that, as a rule, no one examines the scrotum after operation, unless there is so much trouble there that the patient complains

Certainly at the New York Hospital, under the same Visiting and House Staff, the records of a series of consecutive hernia operations, immediately prior to the commencement of our study, mention only 5 per cent of post-operative swellings, although careful bedside notes were made, describing the progress of the wound itself

The application of some form of scrotal support by adhesive plaster strapping, adhesive plaster "bridge," triangular muslin perineal support (Keen), was the routine procedure immediately at the close of operation

But in my experience no one of these devices is efficient in supporting the scrotum unless constantly watched, furthermore, I do not believe that the tumefactions result from mere dependency of the scrotum, and so question very much the prophylactic value of the routine employment of scrotal supports

At any rate 48 per cent developed swellings despite the supports



## POST-OPERATIVE HYDROCELES

A brief analysis of the 20 hydroceles which developed in our series of 148 operations shows that they occurred ten times following very large scrotal sacs which required much scrotal dissection, four times with congenital sacs, six times with funicular sacs

Two factors then emerge in the etiology of hydrocele, to wit Trauma to the tunica, in extensive dissection, the presence of congenital or of funicular hernial sacs

As for funicular sacs, we are dealing with a developmental defect These sacs are usually long, narrow, intimately inserted in the cord structures, with delicate walls, often presenting one or several constrictions or complete obliterations forming small hydroceles of the cord, and occasionally with tiny communications into the tunica

With this peculiar anatomical structure, it is quite possible that when one dissects away the supposed apex of the sac one is really tearing across an imperfectly closed tube which may have communicated with the tunica, and this insult to the tunica may induce hydrocele, just as hydrocele results almost uniformly from attempts to reconstruct a tunica out of a congenital hernial sac

In the 4 cases of our series where a new tunic was constructed out of a congenital sac, all developed hydroceles, 2 of which have persisted to the present time

We agree entirely with Bloodgood that in all cases of congenital hernia the tunica should be excised, "for hydrocele follows in the majority of cases in which it is sutured to form a new tunica"

Following operations on the tunica, we found 4 hydroceles, after 4 reconstructions of the tunica, 1 hydrocele after 7 "bottle" operations (Andrews), 3 hydroceles after 6 Winkelmann partial excision and suture, 0 hydroceles after 5 von Bergman total excisions

## DEATHS

There were two deaths among the 120 individuals, one died on the twenty-third day after operation as the result of pneumonia and pleurisy, the other man died of pulmonary embolism on the eleventh day when he first got up from bed At operation, his deep epigastric vessels had been ligated and divided

## RECURRENCES

Up to date there are recorded 9 definite recurrences in the series of 148 cases, or 6.08 per cent, but the difference between oblique and direct recurrences is so striking that they must be considered separately

After 102 operations for oblique hernia there are but two definite recurrences, or 2 per cent

After 46 operations for direct hernia there are already 7 definite recurrences, or 15.2 per cent

There are, however, reported 6 cases (3 direct and 3 oblique), in which

## INGUINAL HERNIA IN THE MALE

later examination shows some noticeable bulging or weakness or diffuse impulse, but without any definite recurrence. Whether these cases may later develop true recurrences, further observation alone will reveal.

Three of the true recurrent cases were noted before operation to have extremely poorly developed abdominal muscles, two others were operated upon for already recurrent hernia, and some other explanation might be adduced to explain each of the remaining cases.

Five of the nine recurrences have developed upon one side following the repair of bilateral herniæ (1 oblique and 4 direct).

It is of considerable interest to note that in four of these five cases, the side to recur was that side which had been first operated upon.

This may require a word of explanation concerning the technic of bilateral hernia operations on the Second Division of the New York Hospital—namely, that one side is operated upon and completed, next, the other side after a complete change of instruments and draping, thus making in reality two distinct operations.

The neck of the first hernial sac then has been transfixed high up and doubly ligated and the wound closed, now when the opposite side is operated it is quite possible that in the effort to close the sac high up, undue traction is exerted across the midline upon the recently ligated first sac and slipping of the ligature may take place.

This is no mere conjecture of the writer but is based upon actual experience and inspection during the simultaneous operations upon bilateral herniæ by the operator and an assistant, when it is very easy, especially in direct hernia, for one operator, by tugging on his sac, to exert much traction on the opposite sac.

In one instance in our series, upon opening the sac on the second side, free blood was seen in the peritoneal cavity, evidently coming from the opposite side, which was, of course, at once reopened and the ligature found to have slipped from the neck of the sac.

### ATROPHY OF TESTIS

Atrophy of the testis as a result of hernial operations occurred twice, in one case it followed a large oblique hernia which developed a postoperative hydrocele and hæmatoma, the other case was a recurrent direct hernia with marked induration of the testis and cord following operation.

### TYPES OF OPERATIONS

In the 148 operations in our series there were 129 Bassini operations, including 12 rectus transplantations, 13 Ferguson operations, 6 Halsted old operations with wide transplantation of the cord to lie beneath the subcutaneous tissue.

In 2 cases a Pfannenstiel incision was used for bilateral herniæ.

In 6 cases the deep epigastric vessels were ligated and divided.

Appendectomy was added in quite a number of right-sided herniæ.

NON-DESCENDED TESTICLE

There were 4 such cases treated by the Bevan method, and at the end of from six to ten months we find 2 cases which are satisfactory in that the testis is well down in the scrotum, but in the other two cases the testis remains very high in the scrotum, just below the external ring

CONCLUSIONS

1 That oblique herniæ are certainly in the majority of instances of developmental origin, they are more often unilateral, and right-sided, they are often associated with hydrocele of cord and of tunica, but recurrence is less frequent than with direct hernia

2 That direct herniæ are acquired herniæ, are very frequently bilateral, are not associated with hydrocele, but are very prone to recurrence

3 That in bilateral hernia the sacs on the two sides are nearly always of the same general type, obliques or directs

4 Hydrocele of either tunica or cord, on the same side as a hernia, will point definitely to the diagnosis of oblique hernia, usually of either the congenital or of the funicular process types

5 That persistent hydrocele is a common and important after result of oblique hernia operations

In conclusion we wish to express our thanks to our colleagues on the Attending Staff, and to the members of the House Staff of the Second Surgical Division of the New York Hospital, for their very great assistance in recording data for this study

# FRACTURES OF THE OS CALCIS

A STUDY OF SEVENTY-TWO CASES

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THE cases studied were treated in the wards of the surgical services of Bellevue Hospital from the year 1911 to 1915. Practically all the cases were among the working class of people as seen in a large city.

Fractures of the os calcis form from 2 to 4 per cent of all fractures. Usually the condition was either overlooked or a mistake was made in the diagnosis until the injured foot and ankle was submitted to the X-ray. An increasing number of these fractures have been seen and reported upon since the absolute necessity of the X-ray has been realized in the diagnosis and the treatment of fractures.

The mechanics of fracture of the os calcis can be easily explained. The calcaneum forms with the cuboid an arch, which is part of the bony structure forming the arch of the foot. The anterior part of this arch is composed of the tarsal and metatarsal bones, and on account of the number of joints is extremely elastic. The os calcis is the base of the posterior pillar, and the structure of the os calcis is such that it gives the greatest carrying strength for its weight. A fall, the usual cause of injury to the os calcis, causes a breaking down of this arch, generally in the direction of the posterior pillar. This is due to the fact that the posterior pillar is more directly under the line of the body, is more rigid and less elastic, is shorter, and its arch has a longer arc. The very much denser astragalus on top of the calcaneum, articulating with two facets, an anterior internal concave and a posterior external convex, is usually driven into the calcaneum. The anterior facet of the astragalus, being convex and fitting into the concave facet of the calcaneum, acts as a wedge and from this point the fractures usually run. The posterior part of the calcaneum receiving most of the counter pressure is driven upwards and backwards. The fracture is usually impacted and comminuted. The pull of the strong calf muscles has influence in the displacement of the posterior fragment. If the crush is severe and the comminution is marked, the displacement is almost as marked laterally as posteriorly.

Fractures of the os calcis are fractures of adult life. The average age of the seventy-two cases was forty-one years. The youngest case was fourteen years and the oldest was seventy-three years. Since, the writer has seen two cases in children, younger than in these cases, one eleven and the other twelve years. These two cases were the only cases of fracture of the os calcis seen in an active children's surgical service in over a year and a half. Both of these cases were due to crushes. The rarity of the fracture in children is probably due to the elasticity of children's feet and that they

are formed of such a large proportion of cartilage In dividing into the age periods, the fractures occurred as follows

10 to 20 years	2	40 to 50 years	15
20 to 30 years	8	50 to 60 years	11
30 to 40 years	29	60 to 70 years	1
70 to 80 years	2		

The fractures occurred in a very marked preponderance in males over females, the proportion being 68 to 4 This is no doubt due to the fact that males through occupation are much more exposed to injuries

The causes of the fractures were as follows

(1) Falls Sixty-three of the cases were due to falls The distances varied from two feet to six stories One case came down in a hoisting chair, as fast as the drum could unwind, for a distance of twenty-two stories, landing in a sitting position The greater the distance fallen, caused as a rule the more marked fragmentation, although there were several cases in which a fall of only 4 to 5 feet caused considerable comminution The highest fall in which a simple fissure fracture without displacement occurred, was forty feet The cases over fifty years of age showed as a whole shorter distances travelled with more marked comminution of bone In the two cases occurring over seventy years the falls were only two and three feet The youngest of the cases, a boy of fourteen, fell only four feet

(2) Crushes Four cases were due to this injury One case was, in which a large flagstone came down on the heel from behind, crushing the foot, extensively comminuting the os calcis One case was run over by a wagon and two cases were run over by automobile trucks One of the cases run over by an automobile truck had a simple detached fragment of the posterior part of the os calcis, and the other two were bad comminuted fractures

(3) Two cases had the foot caught in the groove of tracks while running and the momentum caused a fracture by twisting One of these was a simple fissure fracture of the upper surface down through the greater process, just anterior to the articular surface of the astragalus The other case was a comminution of the body with very little displacement

(4) One case was of undoubted muscular action, in which, while running for a car a sharp severe pain was felt in the back of the heel with immediate disability This was a fracture of the posterior tuberosity with considerable upward displacement

(5) One case was caught by the heel in a pulley, after slipping, while six stories in the air He remained suspended by his heel for several minutes This case was a fissure fracture of the superior surface just anterior to the anterior articular facet, with no evident displacement

The right os calcis was fractured thirty-three times, the left os calcis thirty-one times, and both were fractured simultaneously eight times All of the double fractures were due to falls Six showed both os calcis extensively comminuted One case had a simple fissure fracture of the left

with comminution of the right, and the other case had simple fissure fracture of each os calcis with no evident displacement

The os calcis was fractured at the same time with other bones in eleven cases. The other bones were as follows: lower end of fibula, three times; tibia alone once; metatarsals, the first, second and fifth, once; femur and humerus once, femur, tibia and humerus once, and with the scapula once. These were all due to falls with the exception of the one associated with fracture of the metatarsals and that was due to a crush by a flagstone.

An attempt was made to classify the cases according to the report of Cabot and Binnie, but it was found impracticable as there were too many cases that would be on the borderlines. However, Cabot and Binnie's classification may be here quoted as follows:

(1) Fractures of that part of the body lying behind a vertical plane through the middle of the body of the astragalus, and those cases may be subdivided into special groups:

(a) Cases with one large heel fragment

(b) Cases with small heel fragment corresponding to the avulsion fractures of authors

(c) Cases showing cracks and fissures but no actual separation of fragments

(2) Those in which the force of the blow has been extended upon that portion of the os calcis lying between astragalus in front of the plane mentioned above, *i e*, the anterior half of the bone. These fractures are nearly always comminuted.

(3) Cases in which the whole os calcis is crushed and extensively comminuted.

Cotton stated that the attempt to classify the fractures of the os calcis is about as useful as classifying cracks in a walnut, after the nut-cracker is through with it. The heel-bone is mashed down and there are all sorts of lines to be found.

Lounsbury divided his cases into five classes as follows:

(1) Those through the concave facet beneath the convex facet of the astragalus

(2) Vertical fractures from just in front of the tuberosity running beneath, to a point just behind the posterior border of the convex articulation, with displacement upwards of the posterior fragment

(3) Tear fractures, usually of the tuberosity

(4) Combination of two or more of these types

(5) Compound fractures

In attempting to classify the seventy-two cases studied, it was found impossible with any degree of certainty to place them in the different types, so the method was used as follows which would also divide the lines of treatment:

1 Simple fissure or linear fractures without any displacement

2 Linear fractures with displacement

3 Comminuted fractures with little displacement

4 Comminuted fractures with marked displacement

Simple fissure fractures occurred upon the superior surface usually under the convex surface of the astragalus, and the line of fracture runs usually downwards and backwards, varying in distance, but generally from one-third to one-half the depth of the bone. This type was seen fourteen times in the seventy-two cases, more often than was expected. All these cases were due to falls. Fissure fractures were seen more often in the falls of shorter distances. They are a cracking of the superior surface of the os calcis from the force of the much harder astragalus.

Linear fractures with displacement occurred in the posterior part of the bone as a rule, usually running down through the tuberosity with a flattening out of the curved-under border of the os calcis due to upward displacement of the posterior fragment. This type occurred ten times. Eight of these were due to falls, one of the other two was due to muscular action and the other was due to a crush. The fragment was impacted seven times and loose in three.

Comminuted fractures without marked displacement occurred seventeen times. These cases showed numerous irregular lines running through the bone, but the general outline of the os calcis remained about normal. The arch of the foot showed no marked flattening. All of these cases were due to falls.

Comminuted fractures with well-marked displacement of the fragments occurred thirty-nine times. The lines at times had a rather stellate appearance, radiating from the anterior upper surface. The posterior fragment, or fragments, were displaced backwards and upwards, the other fragments at times are impacted into each other or what is much more common, they are displaced laterally, that is outwards, and sometimes very markedly. The arch of which the os calcis forms the posterior pillar is flattened out.

The signs and symptoms of fracture of the os calcis are pain in the ankle and heel, with absolute inability to bear the weight of the body on the foot. The swelling is usually marked and is most pronounced under both malleoli. At times, usually in the comminuted cases, the distance from the malleoli to the ground looks shorter in the affected foot. The most marked points of tenderness are below the malleoli and over the heel. Ecchymosis is usually a little late in appearing. Contrary to the idea stated in text-books that crepitus is common, this sign was only made out in ten cases. Three of these were simple fractures of the posterior part of the os calcis with displacement, while the other cases were all comminuted ones. Motion is impaired at the ankle, more marked in lateral motion than in flexion and extension. In making a diagnosis of the type of fracture, it is practically impossible to do so without the use of the X-ray.

The treatment of these seventy-two cases fell into three groups (1) Operative, (2) immobilization without any attempt at reduction, (3) immobilization with attempts at reduction.

## FRACTURES OF THE OS CALCIS

Two of the cases were operated upon. One case with a linear fracture of the posterior part of the calcaneum with marked upward displacement of the posterior fragment was treated by nailing the fragment back through a posterior incision. The result was poor, the tendo Achillis sloughing, with subsequent disability following. The other case was one with a loose fragment of the posterior part of the os calcis with very marked upward displacement of the posterior fragment, which was sutured back with kangaroo tendon. The subsequent result as far as followed was very good. The majority of the cases, fifty-six in number, were treated by simple immobilization with either a circular plaster cast or a molded plaster splint. The foot was placed as a rule in a position at right angles, as far as possible, to the leg. The cases in which the os calcis was fractured alone, as a rule, were made ambulatory with crutches and discharged as soon as possible. Generally the cases were lost sight of, the casts being removed in the Out-patient Department or in some other clinic.

Of those cases treated by immobilization with attempts at reduction there were fourteen. All of these cases were treated by manipulation in an endeavor to loosen the displaced fragments, manual traction made upon the heel, and the leg and foot put up in a circular plaster with the foot in extension in an endeavor to relax the pull of the calf muscles.

An endeavor to trace the cases was very discouraging and the results obtained were so few, that no accurate conclusions could be drawn for a report on the subsequent results. A study of the cases gives no evidence that would lead one to believe that they would be any better than the late results of others. The results are generally poor. Cotton in a recent article shows that the end results in cases treated by the ordinary methods as a rule are rather discouraging. To this everyone who knows anything about fractures of the os calcis agrees.

Simple linear or fissure fractures of the upper surface, while being comparatively few, give the best results to treatment. They show so little displacement that simple immobilization with the foot extended to relax the tendo Achillis, is no doubt the treatment. The number of this type in this series is higher than usual. The cast should be left on for a period of four weeks and should be followed with a course of passive motion and massage for a period of three weeks or so longer. The weight should not be borne on the foot for at least six to seven weeks after the injury.

The cases in which there is a linear fracture, usually of the posterior part with upward and backward displacement of the posterior fragment, unless treated with a view of reducing the displacement, will give a more or less permanent disability. Manipulation with the patient under anæsthesia may release the impaction usually present, and putting the foot up in plaster with the foot extended to relax the pull of the calf muscles,



occasionally will correct the deformity and give a good result Lounsbury stated that it had failed in every instance in which he had tried it Cabot and Binnie, in order to pull the fragment down, passed a urethral sound above the os calcis inside the tendo Achillis, and making traction downwards reduced the displacement Cotton recommends the same procedure, but uses a pair of ice-tongs instead of the urethral sound in order to get a better grip Lounsbury after reduction cuts the tendo Achillis to prevent the pull of the calf muscles During the reduction he had counter pressure made by an assistant by pulling upwards across the sole of the foot with a section of a gas pipe He exaggerated the arch of the foot by pulling the toes and the heel together, and applied his plaster so that this elevation was maintained Open operation with nailing of the fragments has given very poor results, and in the only case in which it was done, in the cases studied, it was followed by sloughing of what was thought to be the tendo Achillis Lounsbury, in his discussion of nailing, gave his opinion that this is just what follows In fractures of the extreme posterior part, the so-called tear fractures, operation with a suturing of the fragment back in place with kangaroo tendon suture, drilling both fragments in order to have a firm hold, is the only treatment It may be necessary in some cases to cut the tendo Achillis in order to bring the fragment down

Comminuted fractures without marked displacement do not give good results treated by the ordinary methods Even if there is no evident marked alteration in the outline of the os calcis, there is always some slight flattening of the arch, and a broadening of the foot, and what is more important, adhesions in the calcaneo-astragalo joint In some of these cases manipulations with overcorrection of the arch and immobilization may give a good result

Comminution with well-marked displacement forms the larger number of these fractures This is the type in which the results are usually bad The lateral displacement is generally overlooked, and the amount can only be judged by a fluoroscope or an X-ray taken from behind—something that is rarely done Cotton has laid down rules for this class of cases that might well be quoted

- 1 Loosen up the fracture by manipulation
- 2 Pull the heel down He used to put a sound through from the side to in front of the heel-cord, and pull down, laterally an ice-tongs is used as easier to handle and affording a better grip
- 3 Free the joint motion between astragalus and calcis
- 4 Push in the displaced bone under the external malleolus, this narrows and shapes the whole bone This is done by striking with a big mallet on the outer side of the foot, padding with felt to take the blow, supporting the inner side of the foot on a sandbag This impacts and, owing to the fact that the outer plate is firm, the impaction is usually fairly solid

## FRACTURES OF THE OS CALCIS

5 Put the foot up in plaster, not at right angles but with the heel-cord slack, also direct pressure on the heel is to be avoided

The after care of fractures of the os calcis is long and tedious. Massage and passive motion must be kept up and all attempts made to improve the lateral motion of the foot, for this being due to interference with the calcaneo-astragalo joint. Pain in the sole of the foot is a frequent late symptom and undoubtedly is due to a flattening of the arch of the foot. This may be relieved by proper filling arch supporter or properly applied pads. Pains in the heel or under the external malleolus are usually due to spurs of callus, and had best be treated by removal of the protrusions.

# AN ANATOMICAL AND EXPERIMENTAL STUDY OF SACRAL ANÆSTHESIA

BY JAMES E THOMPSON, F R C S (ENG )

OF GALVESTON, TEXAS

SACRAL anæsthesia has become so firmly established in the surgical clinic of the John Sealy Hospital as one of the safest and most valuable means of producing local anæsthesia in the regions supplied by the sacral nerves, that it has passed completely beyond the experimental stage. It is used as a routine procedure in all operations on the anal canal and lower rectum, in perineal operations, in external urethrotomies, and in operations on the body of the penis. Also, when combined with local infiltration of the abdominal walls in cystotomies and suprapubic prostatectomies. We have been following pretty closely the method advised by Harris, of Chicago, and it is our custom to inject 30 c c of the solution into the sacral canal and give it sufficient time to diffuse along the space outside the dura mater where it bathes the peripheral nerves before they pass out through the intervertebral foramina. The quantity injected is 30 c c, and the solution is made by dissolving three No. A tablets in 30 c c of distilled water and adding 10 drops of a 50 per cent solution of calcium chloride. (The composition of the A tablets is novocaine, 0.125 Gm., suprarenin, 0.000125 Gm.) As a rule one injection is sufficient, and at the expiration of half an hour anæsthesia is complete in the branches supplied by the sacral nerves. We have injected a second time not infrequently and have never failed after a second injection to secure perfect anæsthesia. The quantity of novocaine used has been considerable, as much as 0.750 Gm. having been introduced into the peridural space in the two injections. As far as our experience goes we have never seen evidence of toxic symptoms.

The period of onset, the area of distribution and the intensity of the anæsthesia show considerable variation. We have found that the region of the anus seems to lose its sensibility first, and that operations involving cutting and burning can be performed within ten or fifteen minutes after the injection has been made. The patient will often resent rough dilatation of the sphincter even though anæsthesia may be complete to the knife or cautery. We have not been able to establish any definite sequence in the order in which the sacral nerves are affected, although we believe that the effect is more rapid the nearer the nerve trunk lies to the bulk of the fluid injected. We have found that the greatest intensity of action is shown in the areas supplied by the sacral nerves from the second downward, but that it extends in many cases upward beyond the second sacral as high as the upper lumbar and lower dorsal nerves. In one case the injection was made at 10.17 A. M., and at 11.16 A. M. anæsthesia was complete below the level of the umbilicus, and was associated with loss of sensation and motion in both legs (see Chart, Fig. 3,

# SACRAL ANÆSTHESIA

Case B) The regions supplied by the first lumbar and twelfth dorsal nerves are anæsthetized in a large proportion of cases, and sometimes the anæsthesia is deep enough to allow us to perform operations on the scrotum, inguinal region, dorsum of the penis, and the suprapubic region of the abdomen. We have, however, found that in women the clitoris and labia minora do not often

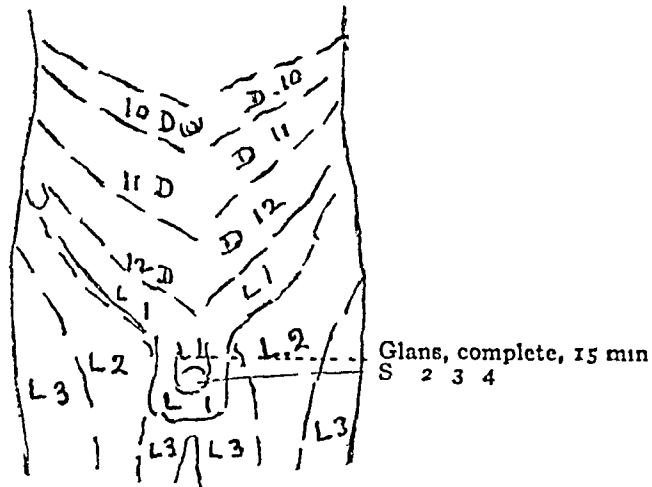


FIG 1—Male Anterior view Structure of urethra

lose their sensibility completely. In some cases of cancer of the cervix uteri the introduction of a large vaginal speculum has been painful, whereas extensive cauterization of the cervix and upper vaginal wall has been absolutely painless.

The appended charts, which were designed for our use by my colleague, Professor William Keiller, have been of great service in enabling us to show

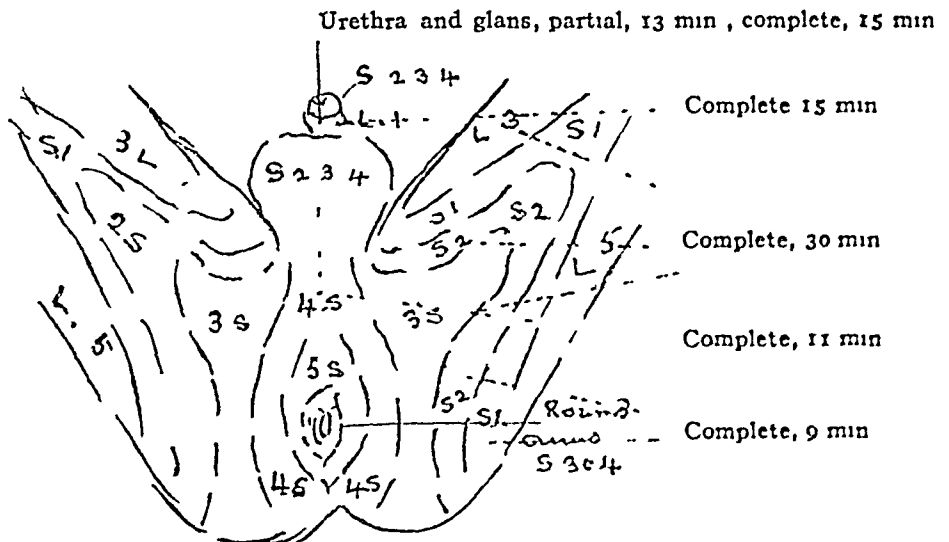


FIG 2—Male Perineal view Structure of urethra

in a graphic manner the area of anæsthesia, the time taken for the anæsthetic to produce its effect, and the spinal segments affected. Two pairs of these charts, one of a male (Figs 1 and 2) and the other of a female (Figs 3 and 4) are exhibited as types. On reflection it seemed probable that the anæsthetic effect was produced by the absorption of the drug into the peri-

pheral nerves outside the dura mater and that the intensity of the effect would be greatest in the nerves closest to the side of injection. This is evidently borne out by experience. The injecting needle seldom passes higher than the third sacral vertebra, and the bulk of the fluid is injected at this level, producing its maximum effect in the sacral nerves. A fair

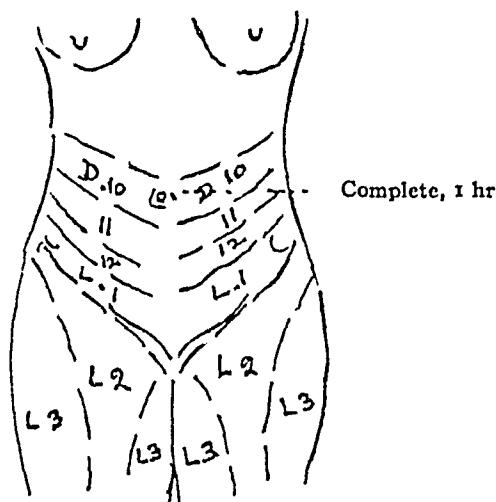
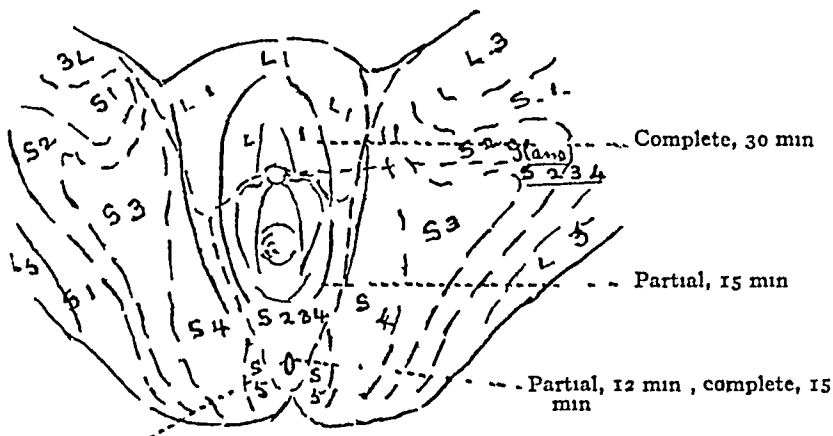


FIG 3—Female Anterior view Case B Loss of sensation and motion in both legs Complete loss of sensation as high as the umbilicus

quantity of the fluid probably flows much higher and produces an anæsthetic effect on the upper sacral and lumbar nerves, and even on the thoracic nerves. This is of much less intensity, and in the majority of cases is rarely complete. In a few rare instances, however, we find sensation and motion lost in both legs and anæsthesia complete as high as the lower thoracic nerves.



Complete, 12 min

FIG 4—Female Perineal view Stricture of rectum Case A

The fluid evidently becomes diffused to a very high level, and we have been able to demonstrate this effectually on the cadaver. During the last winter, by the courtesy of Dr William Keiller, I was allowed to follow the experiments upon cadavers used by the junior class in surgical anatomy. Fifteen bodies were used, and in each case 30 c c of aqueous solution of eosin was injected into the sacral canal. A needle 6 cm long was used in each case. The dissection of the sacrum and spinal canal was made immediately,

and as soon as the data in this region were obtained the spinal canal and cord were exposed in the thoracic region opposite the spine of the scapula (third thoracic vertebra) Roughly speaking, in every case, in half an hour, the sacral and lumbar regions of the cord were exposed, and at the end of an hour the dorsal region was laid bare

The appended table shows the anatomical findings.

Number of dissecting room table	Level of lower end of dura mater	Upper level reached by the staining fluid
3	Third sacral vertebra	Third thoracic vertebra
26	Second sacral vertebra	Third thoracic vertebra
7	Junction of second and third sacral	Seventh cervical vertebra
9	Junction of second and third sacral	Sixth thoracic vertebra
11	Second sacral	Third thoracic vertebra
5	Third sacral (lower border)	Sixth thoracic vertebra
15	Second sacral (lower border)	First sacral vertebra
17	Junction of second and third sacral	Seventh cervical vertebra
23	Second sacral (lower border)	Third thoracic vertebra
19	Second sacral	Third thoracic vertebra
20	?	Tenth thoracic vertebra
13	Second sacral	Third thoracic vertebra
1	Third sacral (upper border)	Third thoracic vertebra
28	Junction of second and third sacral	Third thoracic vertebra
Demonstration body	Third sacral	?

The following points may be emphasized

1 In only one subject (cadaver No 19) was there a failure to inject This was caused by a curved sacrum and an unusually narrow and flattened canal The peridural was eventually injected through a puncture in the lower lumbosacral region, and the data are given as if the sacral canal had been injected from below.

2 In every case, as a matter of routine, the dura mater was exposed above the third thoracic vertebra (the level of the spine of the scapula) Most of the students did not have time to expose the dura in the cervical region of the cord, but there is every probability that the staining went much higher than the third thoracic In the two cases in which the dura was exposed at the level of the seventh cervical vertebra the outer surface of the dura was so deeply stained as to suggest staining at a much higher level

3. In not a single body was any of the injection fluid found inside the dura mater This means that the needle used slipped alongside the dura mater without puncturing it This observation agrees absolutely with our clinical experience We can only remember one clinical case in which the dura mater was penetrated by the needle It appears from this that there is very little risk of intradural injection

4 In the demonstration body it was noticed that while the injection was being made the eosin solution flowed out from both external iliac veins This suggests that the needle had probably punctured a large vertebral vein and that the fluid was being forced directly into the systemic venous system The possibility of repeating this in a living subject is suggestive

5 In every case there was deep staining of both the anterior and posterior branches of the sacral nerves. The staining reached out far from the bone. As the sacral canal was exposed a few minutes after the injection the diffusion of the coloring matter along the nerve sheaths must have been a matter of a few minutes. It was interesting to notice that the diffusion of the coloring matter extended along all the nerve trunks. Thus the twelfth dorsal nerve was found deeply stained in most of the bodies, and in the cases in which the coloring matter had passed up to the cervical region in any intensity the posterior branches of the cervical and upper dorsal nerves also showed deep staining.

6 It appears justifiable to conclude that the coloring matter injected passed along the peridural space without any difficulty and travelled upward outside the dura mater. In its passage it bathed the peripheral nerves, and some of it passed outward along the lymphatic channels of the nerve trunks.

In not one case did any of the coloring matter gain entrance to the subarachnoid space. The cord and the roots of the nerves were unstained. The path along the peripheral nerves was evidently wide open in the cadavers, because in no instance was any excess of staining fluid found outside the dura mater.

It is, of course, unwise to assume that the paths taken by the staining solution are identical in the cadaver and in the living subject, but our clinical observations have supported the view that the diffusion of solutions of novocaine follows in the main the same paths taken by the stain in the dead-house observations. We have recorded a number of clinical cases in which sacral injections were accompanied by anæsthesia in the iliohypogastric, ilioinguinal and twelfth dorsal nerves.

By the courtesy of Dr O J Potthast, demonstrator of anatomy in the University of Texas, I am able to insert data obtained from experiments performed on fifteen other cadavers dissected by the sophomore class. The following technic was employed. A needle 6.3 cm long was used and 30 c c of an aqueous solution was injected into the sacral canal. The needle was thrust in as far as it would go and about one-third of the fluid injected. As the needle was gradually withdrawn the rest was injected. The sacral canal was opened immediately, but the spinal canal in the upper lumbar and dorsal region was not examined until ten days afterward. The following data were obtained.

In 2 of the bodies the injection had been made intradurally, in 11 the injection was extradural, in the remaining 2 the diffusion of the stain made accurate observation impossible. In both cases in which the subarachnoid space had been injected the stain had passed upward to the base of the brain. In 1 of the cases in which the injection was extradural the stain had passed as high as the attachment of the dura mater to the margin of the foramen magnum. In 2 cases it had extended as high as the cervical segment of the spine. In 1 case, in which the stain had not passed higher than the lower end of the dural sheath opposite the second sacral vertebra,

the stain had passed into the vertebral veins, which were found to be particularly large and dilated. In the other cases the stain extended on an average to the level of the ninth thoracic segments. The average distance of the lower end of the dura mater above the hiatus sacralis was about 5.8 cm. The shortest distance was 4 cm. (in this case the dura mater was punctured). The longest distance was 7 cm. The staining fluid entered the systemic veins in 2 cases. These observations were made immediately after the injection and not at the end of ten days.

A study of the sacral canal and of the hiatus sacralis was thought advisable in order to smooth out the mechanical difficulties of the operative technic. As a rule very little difficulty is met with clinically in passing the needle into the sacral canal. In a thin subject the bony margins of the hiatus sacralis can be felt distinctly. In fat people the bony landmarks are obscure, and a good plan is to introduce the needle about an inch higher up than the end of the sacrum, which can usually be felt plainly. In cases in which the coccyx is ankylosed with the sacrum an extra allowance must be made. The direction of the needle should be upward, exactly in the middle line, toward a point about 2 cm. deeper than the prominent spinous process of the first sacral vertebra. Some resistance will be felt as it penetrates the fibrous membrane closing the hiatus. After this is punctured the needle passes along the canal with ease. It is not necessary to introduce the needle farther than 3 or 4 cm., although our experiments and clinical experience prove that the risk of wounding the dura is very slight. If, however, cerebrospinal fluid escapes the needle should be withdrawn to a lower level until the fluid ceases to flow. Then the injection should be made. If the needle lies in the sacral canal there is practically no resistance to the flow of fluid from the syringe. If it lies superficial to the sacrum there is usually a considerable amount of resistance to the flow and one sees immediately a subcutaneous tumor form at the site of injection. The whole operation can be rendered practically painless by preliminary infiltration of the skin and subcutaneous tissue over the hiatus with a solution of 0.25 per cent novocaine.

For the purpose of making the study more complete we have made a careful examination of the available "sacra" in the dissecting room of the University of Texas. In all thirty-three specimens were examined. The bones had been macerated and cleaned thoroughly so that no fibrous or membranous material had been left attached to the cornua of the hiatus sacralis. A strong straight steel knitting needle was used as a probe so as to preclude any possibility of bending and to imitate as closely as possible the behavior of the needle used for making injections. The probe was passed through the hiatus upward along the sacral canal, and if arrested the locality was compared with that of the sacral foramina and so noted down in the table. The following table gives an analysis of the anatomical features noticed.



JAMES E THOMPSON

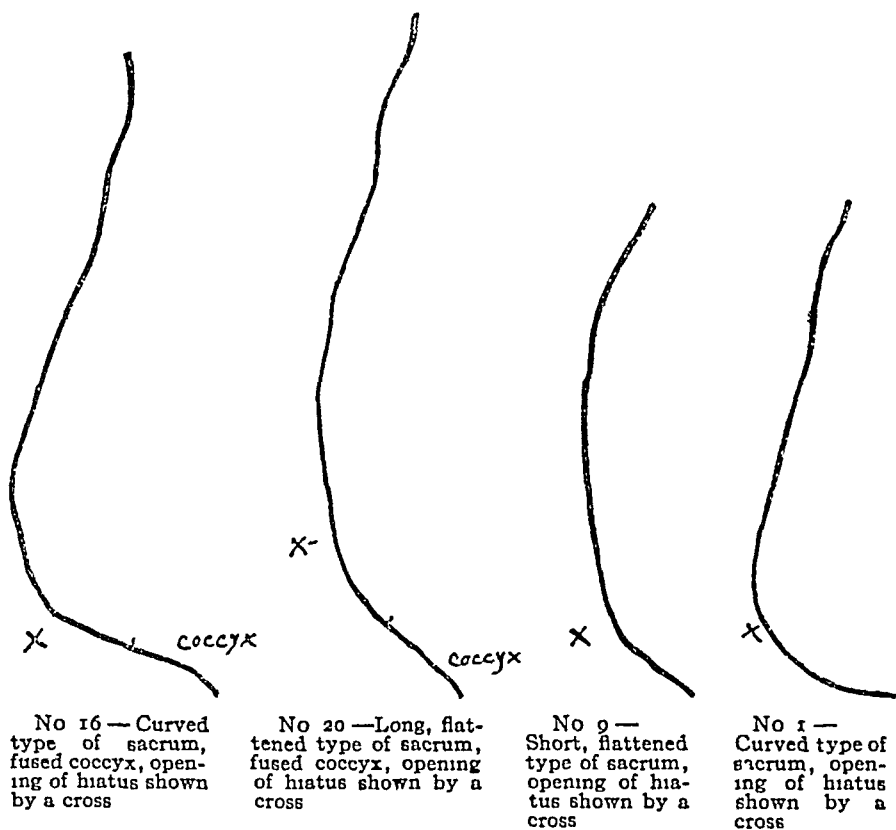
Number of museum specimen	Distance in cm that a probe can be passed upward along the sacral canal from the hiatus sacralis	Upper level reached by the probe	Type of sacrum	Shape of the hiatus sacralis	Level of upper end of hiatus sacralis	Distance between upper end of hiatus sacralis and lower ends of the cornua
1	4.5 cm	2d sacral foramen	Very curved	Horseshoe shaped, short flattened	4th sacral foramen	1.5 cm
2	6.0 cm	1st sacral foramen	Slightly curved	Horseshoe shaped, very long	Between 3d and 4th sacral foramina	2.5 cm
3	Whole canal		Flat	Long horseshoe	Lower part of 3d sacral foramen	3.5 cm
4	5.0 cm	2d sacral foramen	Quite curved	Short horseshoe, fused with coccyx	Lower part of 4th sacral foramen	1.0 cm
5	Whole canal		Flat	Short horseshoe, fused with coccyx	Upper part of 4th sacral foramen	1.4 cm, coccyx fused
6	"		"	Long horseshoe, broad	Lower part of 3d sacral foramen	3.0 cm
7	"		"	Short horseshoe	Lower part of 4th sacral foramen	1.9 cm
8	"		"	Broad horseshoe, fused with coccyx	Lower part of 4th sacral foramen	1.9 cm
9	"		"	Broad, short horseshoe	Lower part of 4th sacral foramen	1.0 cm
10	6.0 cm	Upper part of 2d sacral foramen	"	A shallow curve fused with coccyx	Upper part of 5th sacral foramen	Almost same level as apex, coccyx fused
11	4.9 cm	Between 1st and 2d sacral foramina	Slightly curved	Very long horseshoe	3d sacral foramen	2.7 cm
12	Whole canal		"	Very long and broad horseshoe	3d sacral foramen	3.5 cm
13	5.8 cm	Lower part of 1st sacral foramen	Curved	Horseshoe, very sym- metrical	4th sacral foramen	1.7 cm, cornua very prominent
14	Whole canal		Flat	Sharply triangular	3d sacral foramen	2.6 cm, cornua very prominent
15	"		"	Triangular, blunt at the apex	Between 3d and 4th sacral foramina	2.5 cm, cornua very prominent
16	2.5 cm	Upper part of 4th sacral foramen	Very curved	Horseshoe	Between 4th and 5th sacral foramina	2.0 cm, first coc- cygeal fused with sacrum

# SACRAL ANÆSTHESIA

17	Whole canal	Flat	"	Lower end of 3d sacral foramen	3.5 cm
18	"	Very flat, curved at lower end	Equilateral triangle	Between 3d and 4th sacral foramina	2.3 cm
19	"	Flat	High isosceles triangle	Between 3d and 4th sacral foramina	3.0 cm, cornua overhang 5th foramen
20	"	Quite curved	Long horseshoe	Lower part of 3d sacral foramen	5.0 cm, whole coccyx fused
21	"	"	An isosceles triangle	Between 3d and 4th sacral foramina	4.5 cm, cornua fused with coccyx
22	"	Flat	Short horseshoe	Upper part of 4th sacral foramen	1.0 cm, fused coccyx
23	"	Very curved	An isosceles triangle	Between 3d and 4th sacral foramina	3.3 cm
24	"	Flat	Very irregular	4th sacral foramen	1.0 cm
25	5.5 cm	Curved	Horseshoe with con-tracted ends	Between 3d and 4th sacral foramina	2.0 cm
26	Whole canal	Flat, curved sharply at lower end	An irregular horseshoe	Between 3d and 4th sacral foramina	2.5 cm, anterior and posterior walls of canal almost in contact
27	"	Flat	Horseshoe	Lower part of 4th sacral foramen	2.5 cm, fused coccyx
28	5.8 cm	Fairly curved	Small horseshoe	4th sacral foramen (compare No. 22)	1.5 cm
29	Whole canal	Very flat	Obtuse angled triangle	Between 4th and 5th sacral foramina	2.0 cm
30	"	Fairly curved	Very long triangle	Between 2d and 3d sacral foramina	1.0 cm
31	"	Flat	Horseshoe shaped	4th sacral foramen	2.0 cm
32	"	Very flat	Staple shape	Between 4th and 5th sacral foramina	1.0 cm, canal very capacious
33	"	Flat	Horseshoe shaped	Lower part of 5th sacral foramen	2.5 cm, fused coccyx

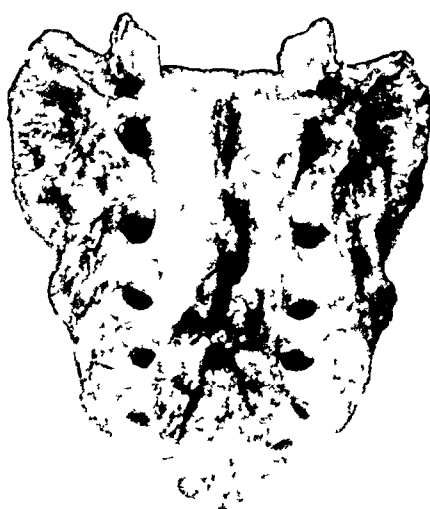
In 24 out of the 33 specimens examined the probe passed along the whole canal. In the remaining 9 it passed in all except 1 (No 16) as high or higher than the second sacral foramen. In this specimen it passed along the canal for a distance of 2.5 cm and reached as high as the upper part of the fourth sacral foramen. The sacrum was very curved, especially at its lower end, and the level of the apex of the hiatus was just below the bend of the curve, between the fourth and fifth sacral foramina. The first coccygeal vertebra was also fused. The specimen is figured in one of the photographs, and a tracing of the curve is also shown in one of the figures.

In only one case was the canal so narrow as to raise doubts whether a needle could be passed along it. In specimen No 26 the anterior and pos-



terior walls were so close together as to reduce the canal to a mere slit, which, however, admitted the knitting needle. In every case of the series the sacral canal was accessible to the needle. Even in No 16, although the needle did not pass higher than the fourth sacral foramen, it entered the canal high enough to allow the needle to pass into the loose cellular space in which the sacral nerves lie. There seems no reason to doubt that if the needle penetrates the fibrous membrane that closes the hiatus and enters this loose cellular space, the injected fluid will pass upward around the nerves and around the dura mater.

PLATE A



No 5 —Sacrum moderately long First coccygeal vertebra fused with sacrum Hiatus fairly large, shaped like a horseshoe Apex of hiatus bounded by an irregular mass of bone corresponding to the spinous processes of the third and fourth sacral vertebræ Fifth foramen complete in front and behind on left side complete in front only on the right side



No 15 —Hiatus large, triangular in shape, blunt at the apex Margins of hiatus irregular and knobby Formed by ununited spines of the fourth and fifth sacral vertebræ



No 29 —Sacrum rather long Opening of hiatus shaped like a small obtuse-angled triangle Margin of hiatus surrounded by massive knobs of bone Apex of hiatus formed by united spinous processes of fourth sacral



No 18 —Sacral very short Margins of hiatus very prominent Opening of hiatus shaped like an equilateral triangle The fourth sacral spines have not united

PLATE B



No. 12 —Hiatus very long and shaped like a horseshoe. The upper end is at the level of the third sacral foramen. The margins of the hiatus are formed by two flattened ridges in which can be seen rudiments of the spinous processes of the fourth and fifth sacral vertebrae.

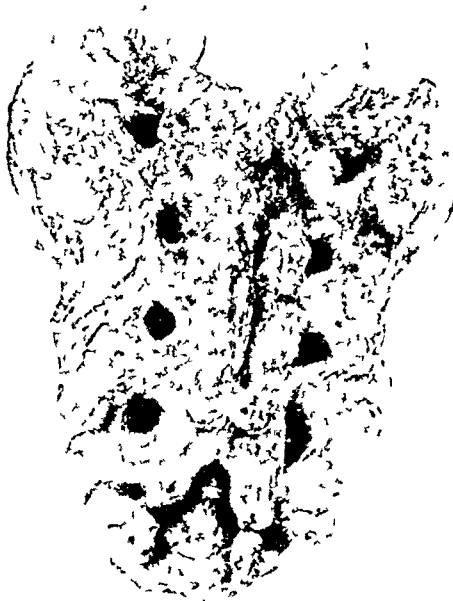
No. 30 —Hiatus very long and shaped like an isosceles triangle. The upper end reaches to the upper margin of the third sacral foramen. The margins are flattened and are formed by the fused spinous processes of the fourth and fifth sacral vertebrae.

PLATE C



No 16 — Showing first coccygeal vertebra fused with sacrum. Upper end of hiatus low down between the fourth and fifth sacral foramina. Hiatus well formed. Margins of hiatus formed by the fused spinous processes of the fifth sacral and first coccygeal vertebrae. The fifth foramen complete posteriorly and anteriorly.

No 10 — Fusion of first coccygeal vertebra with sacrum. The fifth foramen complete in front, represented by a fissure behind. Hiatus represented by a transverse slit at the level of the fifth sacral foramen.



No 27 — Fusion of first coccygeal vertebra with the sacrum. The fifth foramen complete in front, represented by a fissure behind. Hiatus extends upwards almost to the level of the fourth sacral foramen. Margins are formed by the fused spines of the fifth sacral and the cornu of the coccygeal.



## SACRAL ANÆSTHESIA

The appended tracings show the curved and flattened types of sacra (The numbers refer to the table ) No 1 is a tracing of the anterior surface of a markedly curved sacrum. The coccyx was not fused. The cross shows the position of the upper angle of the hiatus. A probe passed as high as the second sacral foramen. No. 16 is also a type of curved sacrum. In this specimen the opening into the hiatus (marked by a cross) was just below the curve and a probe could not be passed higher than the fourth sacral foramen. No 9 shows a short, flattened type of sacrum. The opening of the hiatus is shown by a cross. The probe passed along the whole canal. No 20 shows a long, flattened type with a fused coccyx. The opening of the hiatus is shown by a cross. The needle could be passed along the whole canal.

The sacra showed such variety that it was almost bewildering to attempt to divide them into types. I have appended three plates which bring into contrast certain peculiar features that deserve consideration. (The numbers refer to the table ) In Plate A four sacra of different lengths are contrasted to show the different position and shape of the hiatus and its margins. In Plate B a type with a very large horseshoe hiatus is shown. The contrast between either of these specimens and that of No 29 in Plate A is striking. In Plate C the type with fused first coccygeal vertebra is shown. The contrast between the shape of the hiatus in No. 10 and that in No 16 and 27 should be noticed.



# TRANSACTIONS OF THE NEW YORK SURGICAL SOCIETY

*Stated Meeting, held October 10, 1917*

The President, WILLIAM A. DOWNES, M D , in the Chair

## FISTULA FOLLOWING NEPHRECTOMY FOR TUBERCULOSIS

DR WALTON MARTIN presented a boy seventeen years old, who was admitted to St Luke's Hospital in February, 1916. He had been suffering for about eight months, his chief complaints being frequency of micturition and dysuria. He had lost weight and for a month before admission had complained of pain in the right side. He was poorly nourished and looked very ill. On cystoscopic examination the orifice of the right ureter was dilated and surrounded by an area of œdema and congestion. The urine from the right kidney was pale and cloudy, the urine from the left kidney was normal. A diagnosis of tuberculosis of the right kidney was made and three weeks after admission the right kidney and the much thickened and rigid upper third of the right ureter were removed. The kidney showed on examination numerous cheesy areas and tubercles, and microscopical examination showed typical tuberculous tissue. The patient recovered satisfactorily from the operation and left the hospital in the third week with the nephrectomy wound healed, except for a small sinus. The sinus did not close and soon began to discharge urine mixed with pus. The boy was kept in the open air and every effort was made to improve his general health, but the sinus continued to discharge, a considerable portion of urine passing out of the sinus each day. Eight months after his operation he was again admitted to the hospital for the discharging urinary sinus. Cystoscopic examination at that time showed a normal bladder and left ureteral orifice. The right ureteral orifice was rigid and patent. After some deliberation it was decided not to operate, but to temporize still further with the hope that the sinus would eventually close. The patient was kept under observation and the sinus irrigated. About five months ago the sinus closed and the boy began putting on weight and is now in excellent health.

Dr Martin said he had shown the patient on account of the discussions as to the proper disposition of the ureter in cases of tuberculosis of the kidney with involvement of the ureter, second, on account of the urine which discharged from the sinus, the urine secreted by the left kidney passed into the bladder and then backed up into the stump of the rigid, diseased and patent right ureter and so out through the nephrectomy wound, and finally to show the satisfactory outcome and the spontaneous closure of the

## THORACOPLASTY FOR CHRONIC EMPYEMA

sinus At the time of the operation the boy was seriously ill and it seemed unwise to prolong the operation sufficiently for the removal of the entire ureter

DR WILLY MEYER said that about fifteen years ago he presented a similar patient, before this Society, he was a man in whom he had ligated the pedicle of a tuberculous kidney with its vessels and ureter en masse, because it seemed unwise to separate them on account of the inflammation. Everything went well until after awhile a sinus developed and the patient said that fluid was discharged whenever he lay down. Observation showed that in standing he remained quite dry, but when he lay down urine flowed from the sinus. I found the cystoscope showed a much ulcerated mouth of the diseased ureter. This had become insufficient, so that in bed the bladder urine simply ran up to and out at the loin. Dr Meyer finally reopened the wound and tied the ureter further down, putting the point of the cautery into the lumen and then tying it. This cured the condition.

He coincided with Dr Martin's views on the inadvisability in weak patients of going further down and removing the whole ureter in these tuberculous cases. He had often divided the ureter as far down as possible and then injected a few drops of pure carbolic. Usually such ureters then take care of themselves. He personally did not recall a single case in which with the tuberculous ureter not completely removed, a persistent, suppurating fistula had followed.

DR ALEXIS MOSCHCOWITZ said that he had seen the development of fistulae in some cases that had been considered exceptionally good cases. He mentioned three cases of tuberculosis of the kidney, among others operated in the past two years. One of them was a very far advanced case. In this case he extirpated most of the ureter. The stump that was left was undoubtedly tuberculous, but much to his surprise the wound healed very promptly. In the second case the diagnosis was made only by finding the tubercle bacillus in the catheterized ureteral specimen of urine. The kidney was not at all enlarged. The nephrectomy was very easy. Several inches of the ureter were extirpated. He sewed up this wound without drainage and it healed in a week or ten days, the patient was discharged in a short time, but returned in three weeks with a tubercular wound! The third case was a counterpart of the last. The kidney and ureter were extirpated. There was no leakage during the operation, but the patient returned in a short time with the wound distinctly tuberculous.

## LATE RESULT AFTER THORACOPLASTY FOR CHRONIC EMPYEMA

DR WALTON MARTIN presented a boy fifteen years old who was admitted to St Luke's Hospital four years ago for a persistent thoracic sinus following an operation for empyema two years previously.

There was a sinus in the posterior axillary line in the neighborhood of the sixth rib on the left side. From this sinus large amounts of pus escaped. Every evening there was a rise of temperature, he looked sick and miserable

and there was a marked lateral spinal curvature. A Schede thoracoplasty was performed, the greatly thickened pleura and chest wall over the large intrapleural cavity were removed. As a result the spinal curvature has become corrected, the boy is straight and vigorous with well developed muscles, notwithstanding the deformity of the left chest.

#### DIVERTICULITIS OF SIGMOID WITH ABSCESS

DR WM A DOWNES presented a man, aged forty-eight years, who for five years had complained of discomfort after meals. Two years ago suffered from an acute abdominal attack accompanied with vomiting and fever. Condition was diagnosed as appendicitis. No operation. Gradually lost weight, and in June, 1917, suffered from a second attack of abdominal pain with vomiting and temperature. This time the pain radiated from the appendix region to the lower abdomen. Urination became frequent and painful. This attack subsided in about ten days. Early in July an X-ray examination by Dr Schultz demonstrated a definite diverticulitis of the sigmoid. On August 1 marked tenderness was found in the region of the appendix and in the suprapubic region, also tenderness in region of gall-bladder. At operation the gall-bladder was found thickened and contained one large stone and a number of small ones. The appendix was the seat of an old inflammation and bound down by dense adhesions. The gall-bladder and appendix were removed. Exploration of the pelvic region showed a mass, just at the brim of the pelvis to the left of the median line, size of a child's fist. A left lower rectus incision was then made to expose this mass, which was found to involve the sigmoid and fundus of the bladder. In attempting to separate the bladder from the gut an abscess containing about one ounce of pus was opened. The bladder was separated with difficulty, and the sigmoid released. Two or three appendices epiploicæ were removed, but no opening found entering the lumen of the sigmoid. A large rubber-dam drain was inserted in the cul-de-sac through the lower wound angle and the wound closed. An uninterrupted convalescence followed, except that a small secondary abscess opened at the end of four weeks, but closed in a few days.

The patient is now gaining rapidly in weight, and is free from all pain, bowels move regularly. He suffers only an occasional twinge in the region of bladder in voiding.

DR JOHN F ERDMANN exhibited a specimen removed from a patient three weeks ago, which had been removed under a diagnosis of carcinoma of the recto-sigmoidal juncture of the colon. In cutting into the hard mass they found a condition of multiple diverticulitis. There are fifty diverticula in a segment of gut  $4\frac{1}{2}$  inches by 5 inches long. Further examination has revealed a malignant portion of the bowel associated with one of the diverticula. This is the third case he had had in which malignancy has arisen from an apparently ulcerated diverticulum.

DR WILLIAM B COLEY said that these cases of diverticulitis are difficult to diagnosticate. In the case of a woman who was operated four and

## INGUINAL HERNIA

a half years ago for a condition supposed to be acute appendicitis, what was supposed to be a colitis had developed, for which a nurse had been giving enemas. After one of these enemas she developed a temperature of 102° and a good deal of abdominal pain, she was tender over the lower abdomen. He could make out an indefinite mass over the lower abdomen a little more to the left than to the right, which seemed to be a malignant obstruction of the sigmoid. When the abdomen was opened they found a mass in the sigmoid so tightly adherent to the tube and ovary that it was impossible to enucleate and remove it and the attempt was given up. She had a small fecal fistula for a few months, but has been in perfect health ever since, and this operation was performed four and a half years ago.

### INGUINAL HERNIA IN THE MALE

DR SEWARD ERDMAN presented a paper with the above title, for which see page 702

#### INGUINAL HERNIA CASES PRESENTING SPECIAL FEATURES

DR IRVING S HAYNES presented a boy, fourteen years of age, who was operated upon January 25, 1910, for the cure of a right congenital oblique inguinal hernia by the Bassini technic. The appendix was removed through the same incision. Hemorrhage from the superficial epigastric on the third day. This was controlled by an additional suture. Uncomplicated recovery. Patient left the hospital on the eighth day.

CASE II —Adult male, operated May 30, 1917, for relief of a small hernia in the left inguinal region present for three years. Has worn truss. For past two weeks has had attacks of intestinal cramps, one very severe. The pain was very severe, with general abdominal tenderness, more marked in left iliac region, but there was nothing to be felt in the inguinal region. Operated. The inguinal canal was filled with a mass of properitoneal fat three or four inches long. There was practically no conjoint tendon, there being a free space from the edge of the rectus to beyond the middle of Poupart's ligament. Fat excised, no hernial sac found, inguinal canal repaired by Bassini method. So far no explanation for intestinal symptoms. Abdomen opened at left of midline, nothing found except an appendix, deeply placed near the middle of the abdomen, hard and injected and covered by adhesions. It was removed. Wound closed. Symptoms have not returned. Dr Haynes called attention to the condition prevalent in fat people, of more or less fat in the inguinal canal and a serious defect in the posterior wall of the inguinal canal. Also to an inflamed appendix causing symptoms of intestinal disturbance, in this case attributed to the hernia.

CASE III —E S, male, operated sixteen years previously for a strangulated hernia on the left side. Recurrence began four years ago, now hernial mass, 6 by 4 inches. Operated, October 14, 1914. Mass of omentum as large as two hands excised. Inguinal region reconstructed by usual technic.

CASE IV—R S, male, operated February 4, 1916, for double inguinal hernia, reducible, and of the oblique variety Bassini method followed

CASE V—E R, male, operated on June 15, 1915, for indirect inguinal hernia on the right side The external ring was one inch in diameter There was also a weak scar following an operation for appendicitis performed nine years previously Elliptical incisions removed the old scar and opened up the inguinal region The appendix region was dissected free and the muscles united in layers A large mass of omentum adherent to the hernial sac was removed with the sac and the repair made after Bassini

CASE VI—A, male, aged thirty-seven, operated September 7 last There was a congenital hernia on the right side and a weakness on the left The appendix was removed through the right hernial incision It was retrocaecal and peritoneal In its removal it was punctured by the teeth of an Ochsner's clamp Precautions were taken and the wound sutured tight At the end of the first week a small mural abscess had to be drained Both sides were repaired by the Bassini technic

CASE VII—H B, male operated September 25 last He had a congenital inguinal hernia on the right side with an open funicular process of large size from the abdomen to the testicle This hernia was dealt with in the usual manner On the left side there was an undescended testicle After exposing the inguinal region there was a small mass protruding through the external ring The canal was opened and the testicle, of good size, occupied the centre There was a large peritoneal pouch, funicular process, from the abdomen to the testicle Testicle freed, funicular process divided across, the abdominal gap closed by suture, and the testicular portion sutured to form a tunica vaginalis The vas and vessels were freed, they were found of sufficient length to permit the testicle to be readily placed in the scrotum, because they were looped downward through the external ring and then returned to the testicle Some redundant tissue was excised The canal was reconstructed and the external ring made rather tight An artery forceps was tunnelled to the bottom of the scrotum and the latter grasped and brought up into the wound A suture of kangaroo tendon was passed through the scrotal and testicular tissues and tied The testicle then placed in the scrotum and the incision closed without drainage Recovery was attended with little reaction There was quite some ecchymosis in the scrotal tissues It is now fifteen days since the operation

CASE VIII—M, male, aged twenty-four Had double indirect inguinal hernia of one and a half years standing The right larger than the left On September 10 last, operations were performed on both sides following the Bassini technic At the same time the appendix was removed through the right incision He left the hospital at the end of ten days

CASE IX—J C Had a right, indirect inguinal hernia A Bassini operation was done on September 5 last The appendix was removed through the same incision Patient left the hospital at the end of eleven days

## INGUINAL HERNIA

Dr Haynes, in regard to the prevention of recurrences, called attention to a condition prevalent in fleshy people. It is the absence of the posterior wall of the inguinal canal. This results when the loop of the internal oblique and transversalis muscles swings from the middle of Poupart's ligament to a narrow conjoint tendon, leaving a broad gap in the posterior wall, and there is nothing to resist bulging at this point except the fascia of the external oblique. This anatomical defect is one of the most essential factors to correct when repairing this region. Then again, in fleshy people there is so much adipose tissue mixed with the muscle fibres and also such thin fascia that overlapping methods, especially in the external oblique, are necessary to reconstruct a really strong layer of the inguinal canal.

Another point in the prevention of relapses is to form an internal ring external to the middle of Poupart's ligament by suturing the internal oblique and transversalis muscles to the inguinal ligament behind the cord.

DR ALEXIS MOSCHCOWITZ said that the fact, notwithstanding the high character of the work done at the New York Hospital, they had had at least 686 per cent recurrences, bears out what he had frequently stated, namely, that one cannot go by textbooks or by published reports regarding the number of recurrences. He was of the opinion that if one could obtain statistics of every hernia operation done, not only of that of the operator who operates a large number of hernias, but also that of the operator who operates only occasionally, the number of recurrences would be considerably higher than is usually stated. Another important point not to be overlooked is that one is in reality dealing with two different herniæ, although they are classed together under the generic name inguinal hernia. Oblique inguinal hernia is, so far as the ultimate cure is concerned, totally different from direct inguinal hernia. The oblique are easily curable, but the direct are very difficult to cure. It makes all the difference in the world what operation is done whether one is dealing with an oblique or a direct inguinal hernia.

He could not agree absolutely with Dr Haynes when he lays so much emphasis upon the fat content of the muscles, it does make some difference, but not of such tremendous importance. Some years ago he did 25 or 30 cases hand running with one recurrence, in which he absolutely neglected to avail himself of the muscle. In other words, he paid no attention to the internal oblique or to the transversalis. After splitting the aponeurosis of the external oblique he transplanted the upper leaf of the external oblique to Poupart's ligament, on top of that he sutured the lower leaf of the aponeurosis of the external oblique. However, now he salves his conscience by suturing the aponeurosis of the external oblique, the internal oblique and transversalis muscle to Poupart's ligament and on top of that he sutures the lower leaf of the aponeurosis of the external oblique.

DR WILLIAM B. COLEY said that surgeons do not pay enough attention to these sequelæ to inguinal hernia. A year ago a very important exposition was made by Lincoln Davis of fifteen hundred cases operated on in the

Massachusetts General Hospital in ten and a half years, in which he laid particular stress on the sequelæ. It is interesting to note that the larger number of sequelæ occurred among the fifty-three operators who have performed the smaller number of herniotomies. The greater the experience the fewer the sequelæ. In 438 cases there were sequelæ worthy of note. 158 cases showed sepsis of some form, 98 cases were slight, in the remaining 65 there was frank suppuration. In 170 cases there were pulmonary or respiratory sequelæ, pneumonia in seven cases and bronchitis in the others. The rarer sequelæ were otitis media, cholangitis, one case, mental trouble in three cases, neuritis in three cases. No mention was made of hydrocele. There were six per cent of recurrences noticed. At the Hospital of the Ruptured and Crippled up to January, 1917, in 5617 operations of the inguinal canal, there were 6 per cent recurrences. In their earlier cases there were a certain number of cases followed by suppuration and they lost one or two cases from sepsis, but in the last ten or fifteen years these cases have been remarkably few and there has been no fatality from sepsis for a great many years. The cases of hydrocele in children are remarkably few. He had seen a number in adults, mostly many years ago. They are usually due to too little care in separating the sac, in handling the tissues of the cord, and particularly in not removing the sac down to the testicle proper. The hydrocele is due to too much manipulation of the cord, making the canal through the upper ring too tight, and causing congestion of the cord vessels.

He had had two or three cases of phlebitis. There is another complication which they used to see in the New York Hospital in the early nineties. There were three cases reported by Dr. Bull of omental tumors following hernia operations. These were inflammatory masses due to ligation of irreducible omental herniæ in one large ligature. In such cases within two or three days or a week a mass could be felt in the abdomen as high as the umbilicus, increasing to the size of a child's head. The temperature sometimes went as high as 103°. One case went on to abscess and death. When they began to tie off the omentum in small masses that complication ceased.

Another complication at the Hospital for the Ruptured and Crippled is caused by the use of non-absorbable ligatures. The patient returns for treatment in from one month to three years with a sinus. A large number of cases was reported by Dr. Bull and himself with a plea for the use of absorbable sutures. In Europe they still use some form of non-absorbable sutures in many clinics. Only a year ago he had under his observation a young man operated on in England in order to join the army, which he was assured he could do within six weeks of his operation. However, his wound did not heal well and he was told to take a vacation as a little sinus had formed, so he came to America and took a position as butler. Dr. Coley found several buried silk sutures with a sinus from his hernia operation and one or two sutures where he had a varicocele operated upon. After a long period his sinus finally healed. Not long ago he had two cases, both operated on in

Europe, where silk was used, and sinuses persisted until these sutures were removed by operation. Kangaroo tendon or chromic catgut fulfils all the ideals of a proper suture and ensures permanent results without these unfortunate secondary recurrences.

One word about the technic as to transplanting the cord. Surgeons should not have an invariable rule to transplant or not to transplant. As a rule he never transplanted in a case associated with undescended testis. They treated 700 cases in which they did not transplant the cord, cases similar to those in which they did, and the results in children showed improvement where they did transplant and in adults the results were even better.

DR WILLIAM C LUSK said that little was ever said of the importance of the transversalis fascia in the repair of inguinal hernia. Transversalis fascia normally occupied the whole floor of the inguinal canal and in indirect inguinal hernia the opening in this fascia through which the hernia came was perhaps the only part of the inguinal canal that actually needed repair and reinforcement. In order to guard against recurrence at the internal ring in these herniæ, Dr Halsted had laid down the principle that the transversalis fascia should be dissected away from the sac at the internal ring so that, in tying off the sac, only peritoneum would be included in the ligature and the stump could then retire behind the abdominal wall. Should, however, the transversalis fascia overlying the neck of the sac be left *in situ* and be included within the grasp of the ligature that tied off the sac, it could be seen that by thus leaving the stump of the sac to protrude through the internal abdominal ring, a source of weakness would be introduced at the very situation where a careful reconstruction of the layers of tissue was needed. When, in operating for these herniæ, the neck of the sac had been tied off independently of its fascial connections and its stump had receded well within the internal ring, then it was that by transplantation of the cord with external displacement of the same into the outer angle of the inguinal canal, which manœuvre coincidently drew into an extreme outward position the transversalis fascia attached to the cord, the opening at the internal ring was automatically closed.

Dr Lusk said that for the repair of direct herniæ he practised Dr Halsted's operation of taking a flap from the anterior layer of the rectus sheath and sewing it to the inner portion of Poupart's ligament. Dr Halsted did not transplant the rectus muscle. Dr Lusk had illustrated the cutting of a rectangular flap from the anterior layer of the rectus sheath for the repair of direct hernia in the ANNALS OF SURGERY, November, 1913, p 677. The anterior layer of the rectus sheath was unyielding, the posterior layer of the rectus sheath contained some slack. By cutting the rectangular flap in the anterior layer of the rectus sheath, the horizontal arm of the flap cutting well out to, but not through, the outer border of the rectus sheath, and the vertical arm cutting downward to the pubic spine, the restraint exercised by this layer of the rectus sheath on the arched fibres of the internal oblique and transversalis muscles was freed and the slack



of the posterior layer of the rectus sheath given play, so that both the arched fibres as well as the rectangular flap could be readily brought down and sutured to Poupart's ligament without tension. The horizontal arm of the rectangular flap should be made about  $1\frac{1}{4}$  inches above the pubic spine.

For protection against recurrences which came as a result of suppuration, Dr Lusk recommended the use of MacDonald's solution for disinfection of the skin instead of tincture of iodine. The wounds for inguinal herniæ, being through hairy parts, were particularly difficult to disinfect. The tincture of iodine containing no fat-solvent could not reach bacteria embedded in greasy particles, but MacDonald's solution containing the fat-solvent acetone, by liquefying the grease, liberated the bacteria imprisoned therein, thus exposing the latter to the action of the disinfectant ingredient of the solution. The formula was 40 parts acetone, 60 parts alcohol, to which 2 per cent pyxol was added. His own experience, and the reported results of some others, spoke for the superiority of MacDonald's solution over tincture of iodine for skin disinfection.

DR WILLIAM A. DOWNES differed with Dr Erdman in reference to supporting the scrotum. It adds tremendously to the comfort of the patient. In private patients he always uses a suspensory immediately after operation. In direct hernia the recurrences are anywhere from ten to twenty per cent. He had been interested in rectus transplantation for many years, and has transplanted in about 300 cases, but even these have shown from five to ten per cent of recurrence in those cases which they had been able to follow.

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